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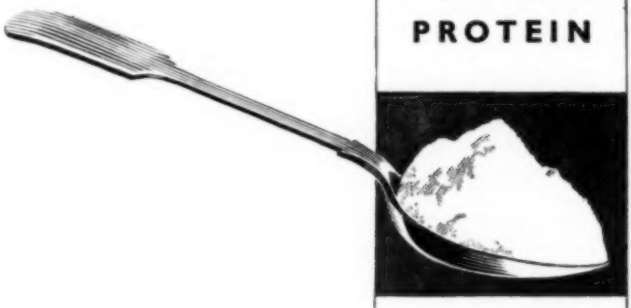

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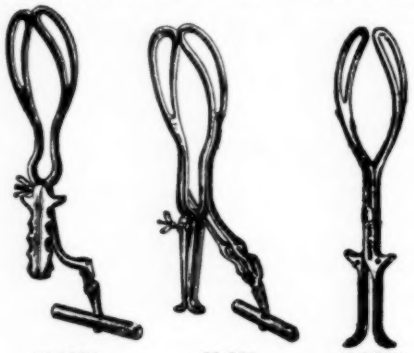

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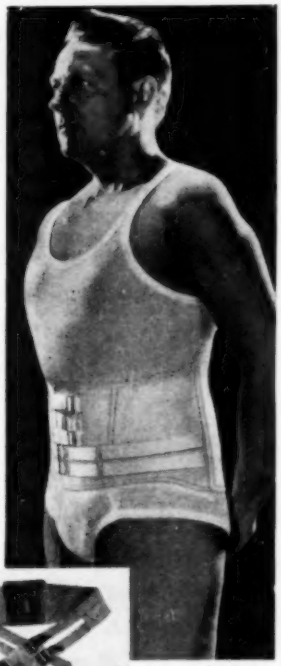

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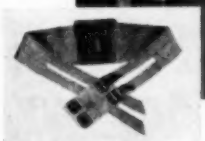

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RESULTS AFTER ONE MONTH'S TREATMENT

	No. of patients	Immediately symptom-free	Slowly symptom-free 7-8 days	Not symptom-free	Free from symptoms after one month
In-patients	160	126 (78.8%)	25	9	151 (94.2%)
Out-patients	242	182 (75.2%)	53	7	235 (97.1%)
TOTAL	402	308 (76.6%)	78	16	386 (96%)

RESULTS OF TREATMENT AFTER 4-6 MONTHS

	No. of patients	Symptom-free	Not symptom-free
In-patients	158	134 (84.8%)	24 (15.2%)
Out-patients	238	197 (82.8%)	41 (17.2%)
TOTAL	396	331 (83.1%)	65 (16.9%)

PERMANENT RESULTS AFTER SIX MONTHS' BISMUTH TREATMENT, OVER OBSERVATION PERIODS OF FROM ¼ TO 16 YEARS

Period of observation	No. of patients	Symptom-free	Considerably improved	Improved	Unchanged
*¼- 2 yrs.	77	47 (61%)	8 (10%)	6 (8%)	14 (18%)
2- 3 ,,	50	28 (56%)	6 (12%)	9 (18%)	7 (4%)
3- 5 ,,	78	38 (49%)	10 (13%)	16 (21%)	12 (15%)
5-10 ,,	93	37 (40%)	11 (12%)	17 (18%)	26 (28%)
10-16 ,,	79	25 (32%)	14 (18%)	20 (25%)	20 (25%)
TOTAL	377	175 (47%)	49 (13%)	68 (18%)	79 (21%)

Complete report will be available from "X" Hospital early 1951.

Full literature on Bismuth Therapy will be supplied by

BISMUTH RESEARCH DEPARTMENT

MINING & CHEMICAL PRODUCTS LTD

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PROCID

Nasal Drops

A new preparation for the treatment of the incipient common cold and established nasopharyngeal infections

"PROCID" Nasal Drops are presented as a stable aqueous solution containing 5 per cent. sodium propionate and 0.8 per cent. ephedrine hydrochloride. The preparation may be instilled into the nostril by means of a dropper, or it may be used in a standard atomizer.

By virtue of the following properties, "Procid" is particularly suitable for intranasal use.

- It is effective against a wide range of micro-organisms.
- Sensitization effects are not encountered, and the compound may be safely administered to patients who have acquired a sensitivity to penicillin or the sulphonamides.
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packings:

"Procid" Nasal Drops are available in the following packings:

Bottles of ½ fl. oz. with dropper.

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- Comprehensive literature and clinical material will gladly be supplied on request.

HS

HARKER STAGG LIMITED

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Good stimulants for the appetite in post-operative and convalescent conditions: Schweppes Dry Ginger Ale, Ginger Beer or Tonic Water.

BY APPOINTMENT
MINERAL WATER MANUFACTURERS
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CLEAN REFRESHING PALATABLE

"*SEDALGESIA*"....

A new noun? . . . . . Maybe!

"*SEDALGESIC*"....

A new adjective?. . . . . Perhaps!

"dormiprin"
tablets

A SAFE "SEDALGESIC"... DEFINITELY!
FOR INSOMNIA AND PAIN.

FORMULA

† *Carbromal B.P.C. 150 mg.* † *Bromvaletone B.P.C. 50 mg.*
Ac. Acetylsal. B.P. 250 mg.
alkalized with Mag. Oxid. B.P. to minimise gastric irritation.

† Carbromal and Bromvaletone are physiologically harmless OPEN-CHAIN UREIDES producing none of the habit-forming and other clinically undesirable side-effects of the barbiturates.

"dormiprin" has no B.P., B.P.C. or N.F. equivalent and may be freely prescribed as it complies with the relevant recommendations of the Cohen Report.

Clinical samples and literature on request

CLINICAL PRODUCTS LTD. CPL RICHMOND ENGLAND

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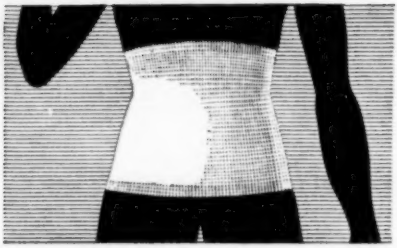
JAEGER



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LIVER EXTRACT (1M)

A highly potent whole liver extract containing, in addition to the true pernicious anaemia principle, the greater part of the other water soluble active substances in the liver, including particularly the members of the vitamin B complex.

Ampoules — 2 cc. Bottles 10 cc. and 20 cc.

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A concentrated preparation of the uncoagulated juice of liver, fortified with iron and glycerophosphates.

Bottles — 3½ and 7 fl. oz.

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Capsules containing liver concentrate reinforced with B group vitamins and minerals.

Bottles of 100 and 500

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Desiccated gastric tissue —

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LITERATURE GLADLY FORWARDED UPON REQUEST

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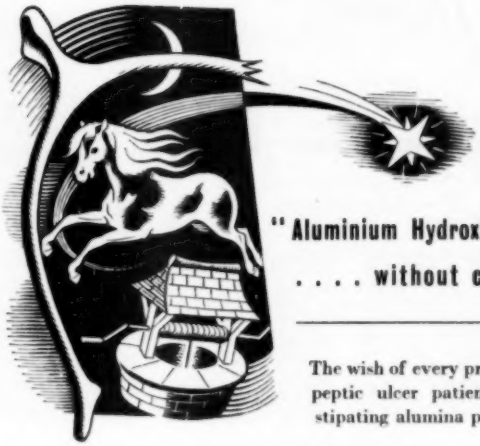

"Aluminium Hydroxide Therapy . . . . without constipation"

The wish of every practitioner for his peptic ulcer patient is a non-constipating alumina product.

Gelusil* Antacid Adsorbent fulfils this wish. Ordinary gels at gastric pH react with gastric hydrochloric acid to produce astringent, constipating aluminium hydrochloride; but the alumina gel contained in Gelusil is virtually non-reactive and the spectre of constipation is thus removed from aluminium hydroxide therapy.

By its formation of a colloidal shield over the inflamed area, and through the uniform dispersion of magnesium trisilicate, Gelusil antacid adsorbent provides, within minutes, relief that lasts for hours.

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In boxes of 50. Also for dispensing only in bulk packages of 500. Not subject to P.T. on prescription.

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3 Calmic Products in Outline

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CIMLAC GAUZE

Based on the findings of Sinclair and Douglas that the local application of gelatin to wounds increased their healing rate, and the tensile strength of wounds so treated was much greater than control wounds. Cimlac Gauze provides a bland dressing incorporating sterilized Glyco-gelatin with Hexyresorcinol and Aminacrine Hydrochloride.

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Cimlac Gauze is compatible with systemic antibiotic therapy and is packed to facilitate non-touch technique.

Hospital Pack : Boxes of 24 pieces 4" x 3½"
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individually packed in heat-sealed moistureproof cellulose tissue envelope. Literature and samples on request.

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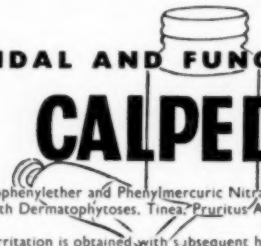

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The combination of Parachlorophenylether and Phenylmercuric Nitrate in Calped provides rapid control of pathogenic fungi associated with Dermatophytoses, Tinea, Pruritus Ani, Pruritus Vulva and allied fungoid infections.

Rapid relief from itching and irritation is obtained with subsequent healing of the lesions.

Available as a cream or powder. Calped can be used therapeutically, or as a prophylactic for Dermatophytosis in communities exposed to the risk of infection through the use of communal showers and baths.

Pack :—CALPED POWDER—4 oz. drums. 1-lb. Jars. **CALPED CREAM** : —4 oz. & 1 oz. tubes. 1-lb. Jars.

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ANALGESIC AND ANTIPYRETIC

Complete and rapid disintegration within approximately fifteen seconds ensures speedy relief from pain by the therapeutic action of a carefully balanced formula containing Acetylsalicylic Acid, Phenacetin, Caffein, Codein Phosphate and Phenolphthalein.

The side effects of constipation and depression often associated with the administration of analgesics is eliminated by the influence of the fractional dose of Phenolphthalein contained in Hypon, and the presence of Caffein which acts as an anti-depressant.

Hypon Tablets are now being extensively prescribed for the relief of pain in Rheumatic conditions, Spastic Dysmenorrhoea, Neuralgia and all conditions where an analgesic is indicated, and as an antipyretic in cases of Influenza, Acute Rheumatism, Tonsillitis and Coryza.

Packs : Available in bottles of 50, 125, 250, 600 and 1,000 tablets. Literature and samples on request

Calmic Limited · Crewe Hall · Crewe

CLINITEST
TRADE MARK

The NEW one-minute tablet test for detecting urine-sugar

Doctors and diabetic patients appreciate the advantages of this convenient tablet method for detecting urine-sugar. Based on the same principles as the Benedict Test, 'Clinitest' provides a copper-reduction test with all reagents compressed in a single tablet.

NO EXTERNAL HEAT REQUIRED. The heat is self-generated by the tablet.

CONVENIENT—PRACTICAL. All essentials fit into a small pocket-size container.

SPEEDY—DEPENDABLE. The test takes less than one minute but the sensitivity and reliability are equal to the other standard qualitative copper reduction tests.

SIMPLICITY. There are three simple steps. Place five drops of urine in a test tube, add ten drops of water. Drop one 'Clinitest' tablet into the solution and allow thirty seconds for reaction. Then compare with colour scale.

NEW PRICES TO THE PUBLIC:
Set, including 36 tablets - **10/-**
Refill Bottles (36 tablets) - **3/6**

Supplies now available through good-class chemists, or from the Sole Distributors. For full information and medical literature write to:

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Sole Distributors for The Ames Company, Inc.
A product of Ames Company Inc., Elkhart, Indiana, U.S.A.

Approved by the Medical Advisory Committee of the Diabetic Association

12

An ideal combination for the relief of asthma

BROVON *Inhalant*

The carefully-balanced combination of adrenaline, papaverine and atropine methylnitrate presented by Brovon Inhalant is an excellent example of synergism—the rapid action of the adrenaline ensures prompt relief, while the slower but more persistent action of the atropine methylnitrate and papaverine give the desirable prolonged effect.

Brovon Inhalant is used for the rapid relief of asthma, particularly during paroxysms and in *status asthmaticus*, and to suppress threatening attacks. It is also effective in relieving the bronchiolar spasm of chronic bronchitis and emphysema.

Brovon Inhalant contains:

Atropine Methylnitrate	1.14% w/v
Papaverine Hydrochloride	0.88% w/v
Adrenaline (Epinephrine)	0.50% w/v
Chlorbutol	0.50% w/v

in a special solvent promoting rapid absorption.

Supplied in ½ oz., 1 oz., 2 oz., and 4 oz. bottles (purchase-tax free)

Please write for a clinical sample and descriptive literature. The Deedon Plastic Inhaler, the favourite for penicillin aerosol therapy, is the best method of administering BROVON Inhalant. If a glass inhaler is preferred, the Brovon Midget Inhaler can be prescribed.

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The relationship between diet and disease is now attracting universal attention. Diet therapy is included in the treatment of many diseases, and is particularly indicated in conditions associated with a shortage of vitamins.

Marmite is a yeast extract containing naturally occurring B$_2$ vitamins. It provides several known vitamins together, as well as unidentified factors, and is, therefore, often prescribed in preference to single synthetic supplements in vitamin deficiency states, which are usually multiple in nature. Besides riboflavin (1.5 mg. per oz.) and nicotinic acid (16.5 mg. per oz.), Marmite contains pyridoxin, pantothenic acid, biotin, inositol and folic acid.

MARMITE

yeast extract

Jars : 1-oz. 8d., 2-oz. 1/1, 4-oz. 2/-, 8-oz. 3/3, 16-oz. 5/9. Obtainable from Chemists and Grocers
Special terms for packs for hospitals, welfare centres and schools

Literature on Application

THE MARMITE FOOD EXTRACT CO., LTD., 35 Seething Lane, LONDON, E.C.3

496/a

ELIXIR GABAIL

The Ideal Sedative in All Nervous Affections

ELIXIR GABAIL combines the sedative action of Bromide and Chloral Hydrate with the nervine and anti-spasmodic deodorised Valerianate. Pharmaceutically it is as pleasant and palatable as it is efficacious from the therapeutic standpoint, the disagreeable odour and flavour of the Valerian having been completely removed without in any way impairing its medicinal value.

In Hysteria and Psychasthenia it relieves nervous excitement and produces a calm state of mind that is conducive to rapid recovery. It is also of value in states of temporary emotional excitement, in Hypochondriasis and Melancholia.

DOSAGE: One tablespoonful in water twice or thrice daily.
As a hypnotic: Two tablespoonfuls at bedtime.

Supplied in bottles of 187 c.c., and 16 oz., also in Dispensing Packs of 40 oz. and 80 oz.

THE ANGLO-FRENCH DRUG CO. LTD.

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new product information

BUFFERED Crystalline Penicillin G, potassium salt, DC(B)L

Crystalline Penicillin G is unstable in solution.
The addition of a suitable buffering agent overcomes this disadvantage. Investigation* has shown that the incorporation of 4.5 per cent. anhydrous sodium citrate permits the preparation of aqueous solutions of crystalline penicillin G which will retain their activity for considerable periods.

We have pleasure in announcing the availability, through our usual distributors, of Buffered Crystalline Penicillin G, potassium salt, DC(B)L in the following packs:

200,000 i.u., 500,000 i.u., 1,000,000 i.u., in boxes of 5 vials.

5,000,000 i.u., and 10,000,000 i.u., in single containers

selling at the same prices as the unbuffered material.

* *Pharm. Jnl.*, 1950, 165, 126

THE DISTILLERS COMPANY
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SPEKE LIVERPOOL

Emotional Stress

plays an important role in the development of functional and, ultimately, of organic disorders. A therapy which prevents the psychic component from acting as a precipitating factor may either prevent the occurrence of organic lesions or contribute to the healing process.

SANDOZ

BELLADENAL

affords relief from stress and anxiety and allays spasmodic conditions in: Mental tension - Functional dyspepsia - Angina pectoris (Interval treatment) - Peptic ulcer - Bronchospasm - Dysmenorrhoea - Travel sickness.

Full clinical information and samples upon request.

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Presentation: tubes of 20 tablets and bottles of 100 and 250 tablets.

Hospital size: bottles of 500 tablets

SANDOZ PRODUCTS LIMITED

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The heart *that is ageing*

In these days when increasing attention is being devoted to the care of the elderly, the use of certain xanthine derivatives has gained considerable favour for improving myocardial function and for patients whose coronaries are probably sclerotic or constricted. A useful representative of this group for routine treatment may be found in

Cardophylin

THEOPHYLLINE-ETHYLENEDIAMINE

VASODILATOR, DIURETIC & RESPIRATORY STIMULANT

Its use is indicated in Angina Pectoris, Coronary Thrombosis, Cheyne-Stokes Respiration, Oedema, and Bronchial Asthma

Supplied in tablets for oral use, ampoules for intramuscular and intravenous injection and in suppositories

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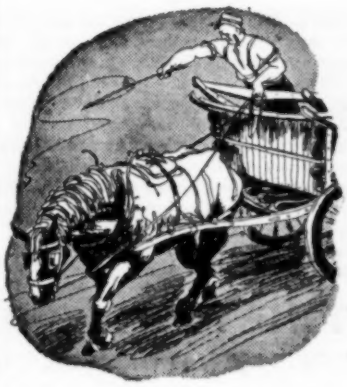
BENGER LABORATORIES LTD., HOLMES CHAPEL, CHESHIRE

Avoid flogging a tired horse

CHANGES in normal routine and restricted or special diets may induce constipation. Purgatives, however, over-stimulate the bowel temporarily and this is followed by inactivity. The tired horse—so to speak—is flogged again and a vicious circle results.

Regular effort and adequate bulk are needed to restore normal routine. 'PETROLAGAR' provides the 'soft bulk' essential to regular peristalsis. Gently but surely it helps the return to 'habit time.'

'PETROLAGAR,' a 25% emulsion of white petroleum oil with flavouring, is issued in two varieties: Plain and with Phenolphthalein.



'Petrolagar' *Emulsion*

Trade Mark

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When Breast-Feeding Fails

Young Mothers do not always realise that, when breast-milk fails—or baby is not thriving—FRESH cow's milk is always available.

★ Liquid cow's milk is Nature's finest substitute for breast-feeding. MODIFIED with a little of Sister Lauras Food, cow's milk (undiluted) is completely digestible by the youngest and most delicate infant.

Sister Lauras Food, a simple cereal product, breaks up the casein—which is so valuable for tissue building—and all the mineral and vitamin content of the milk is unimpaired.

That is why so many Doctors recommend FRESH COW'S MILK, modified with Sister Lauras Food.

FREE PROFESSIONAL SAMPLES, sufficient for a good trial with your difficult babies, are available to Members of the Medical Profession. Write to Sister Lauras Food Co. Ltd. (Dept. PRA/34), Springfield Works, Bishopbriggs, Nr. Glasgow.

From all Chemists

2/4

SISTER LAURAS FOOD

MODIFIES FRESH MILK FOR BABIES

WANTED ON VOYAGE

Here is the Portanæst in use on board ship. It is equally useful in the factory, in the surgery, or when visiting. Completely portable, completely self-contained, it fulfils the need for Anæsthetic or Analgesic equipment anywhere, at any time. A compact, easily transported unit, it leaves nothing to be desired in the completeness of its equipment or the accuracy and facility of its operation. It is the ideal unit for the practitioner working in a confined space, with the minimum of assistance, and with limited equipment. Write for full details. A demonstration will be gladly arranged at your convenience.

THE PORTANÆST

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WEMBLEY MIDDLESEX · RUSHOLME MANCHESTER

Incorporating Coxeter & Son Ltd. and A. Charles King Ltd.

These are the months . . .

OCTOBER · NOVEMBER · DECEMBER

. . . to guard against the dangerous sequelae of head colds

which may lead to chronic nasal infection throughout the winter. The timely use of 'Sulfex' prevents secondary infection and shortens the course of the common cold. 'Sulfex' is available on prescription only in 1-oz. bottles with dropper.

'SULFEX'

Samples and literature on request

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for Smith Kline and French International Co., owner of the trade mark 'Sulfex'
SXP90

For those critical months–

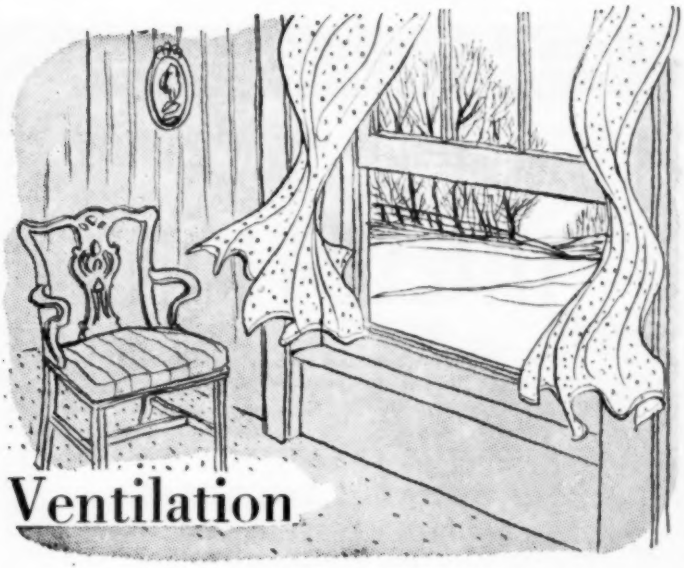
CROOKES B-COMPLEX

QUITE apart from dietary and digestive considerations resulting from the increased physiological demands upon expectant and nursing mothers, modern usage indicates an important role for the B-Complex in the toxæmias of pregnancy, including "morning sickness".

Crookes B-Complex tablets provide standardised amounts of the three essential B-factors together with yeast powder. A specimen together with literature will gladly be sent upon request.

Each tablet contains
1 mg. . . . . Vit. B_1
1.25 mg. . . . . Vit. B_2
10 mg. . Nicotinamide
227 mg. . yeast powder

THE CROOKES LABORATORIES LIMITED · PARK ROYAL · LONDON · N.W.10



Ventilation

NASAL OBSTRUCTION and increased secretion are undoubtedly the most distressing symptoms of the common cold. A prime factor in providing for the patient's comfort therefore is the restoration of normal ventilation.

'ENDRINE' *is a well-tried preparation which contains ephedrine in concentrations harmless to the mucosa yet able to achieve ventilation for several hours.* By its use the patient may be relieved at once of his symptoms and normal function can be restored.

'ENDRINE' is available in three varieties: *Ordinary, Mild and Isotonic.*

'ENDRINE' *Nasal Compound*

Trade Mark

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"IRGAPYRIN"

AMIDOPYRINE 15%

Sod. 3,5-dioxo-1,2-diphenyl-4-n-butyl pyrazolidine
15% in 5 c. c. sterile solution

FOR THE TREATMENT OF
RHEUMATIC DISORDERS
AND THE RELIEF OF PAIN
IN OTHER CONDITIONS

ANTI-INFLAMMATORY
ANALGESIC
ANTIPYRETIC

In boxes of 5 and 50 ampoules

Literature on request

Samples on receipt of signed order

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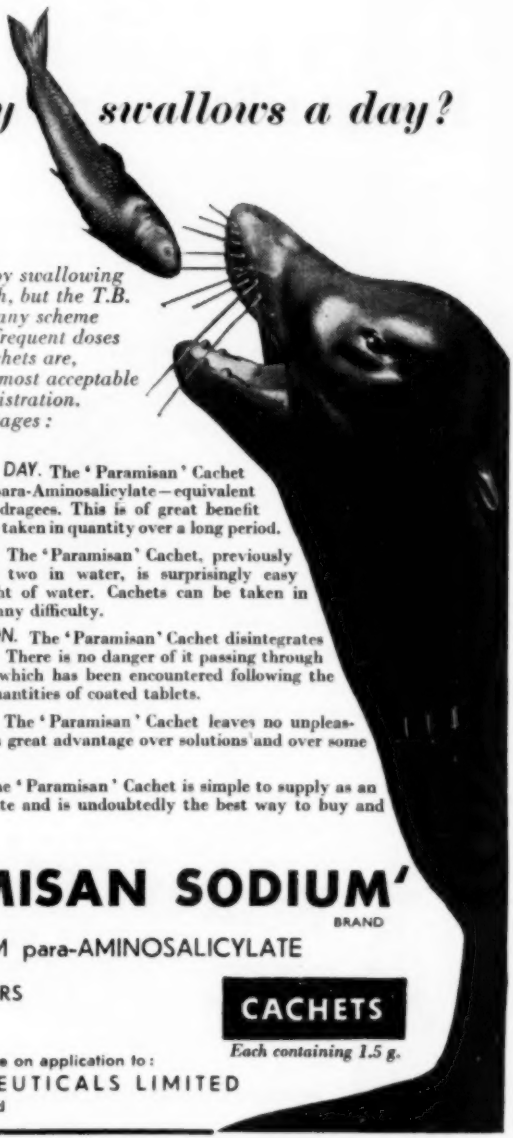
Geigy

PH29

How many swallows a day?



The sea lion may enjoy swallowing large quantities of fish, but the T.B. patient will welcome any scheme to help him with his frequent doses of 'Paramisan'. Cachets are, without question, the most acceptable method of oral administration. Consider these advantages:

LESS "SWALLOWS" PER DAY. The 'Paramisan' Cachet contains 1.5g. of Sodium para-Aminosalicylate—equivalent to nearly five tablets or dragees. This is of great benefit with a drug which must be taken in quantity over a long period.

EASY ADMINISTRATION. The 'Paramisan' Cachet, previously dipped for a second or two in water, is surprisingly easy to swallow with a draught of water. Cachets can be taken in quick succession without any difficulty.

CERTAIN DISINTEGRATION. The 'Paramisan' Cachet disintegrates quickly when swallowed. There is no danger of it passing through unabsorbed—a difficulty which has been encountered following the administration of large quantities of coated tablets.

NO UNPLEASANT TASTE. The 'Paramisan' Cachet leaves no unpleasant taste in the mouth—a great advantage over solutions and over some forms of granules.

ACCURATE DOSAGE. The 'Paramisan' Cachet is simple to supply as an accurate dose, avoids waste and is undoubtedly the best way to buy and administer P.A.S.

'PARAMISAN SODIUM'

TRADE MARK BRAND

SODIUM para-AMINOSALICYLATE

PACKED IN CONTAINERS
of 100 and 500

CACHETS

Each containing 1.5 g.

Literature and prices available on application to:
HERTS PHARMACEUTICALS LIMITED
Welwyn Garden City, England
G.M.56

Prompt relief . . . prolonged effect

'Benzedrine' vapour shrinks the swollen mucous membrane of the nose and thus relieves the heaviness, discomfort, and nasal congestion associated with colds, hay fever, sinusitis, etc. The effect lasts a full hour and makes frequent use unnecessary.

The wide margin of safety and this prompt, prolonged vasoconstrictive action make 'Benzedrine' Inhaler the ideal agent for reducing the nasal congestion accompanying children's head colds and associated conditions.

Children welcome the novelty of 'Benzedrine' Inhaler treatment, showing none of the hostility that is often associated with the administration of 'nose drops'.

'Benzedrine' Inhaler

a better means of nasal medication

Each tube is packed with amphetamine 325 mg. and aromatics

MENLEY & JAMES, LTD., 123 Coldharbour Lane, London, S.E.5

for Smith Kline & French International Co., owner of the trade mark 'Benzedrin'

BIP90

Feather-light casts

Glassona casts are of an open-work structure admitting both light and air, unaffected by water, extremely light in weight, permeable to X-ray and hard wearing — they are ideal for all conditions requiring long-term immobilization.

Casts are constructed from bandages made from a mixture of glass and cellulose acetate fibres. The material resembles stockinette. The bandages are prepared for use by immersion in a special setting fluid. Further details available upon request to the Medical Division of the Manufacturers.

GLASSONA TRADE MARK

THE NEW

PLASTIC SPLINTING MATERIAL

made in England by T. J. SMITH & NEPHEW LIMITED. HULL

A New

AND OUTSTANDING ADVANCE
IN THE THERAPY OF
PEPTIC ULCER AND
GASTRIC HYPERACIDITY

Aluphos
TRADE MARK

PROMPT RELIEF OF PAIN

NO INHIBITION OF PEPTIC ACTIVITY

NO INTERFERENCE WITH THE ABSORPTION OF ESSENTIAL METABOLITES

NON - SYSTEMIC

NO ACID REBOUND

PREVENTION OF FLATULENCE

NON - CONSTIPATING

Further information will be supplied on request to:

BENGER LABORATORIES LIMITED
HOLMES CHAPEL CHESHIRE ENGLAND
Telephone 3112

A New Treatment for—

TRICHOMONAL VAGINITIS

This consists of 6 weekly paintings of the vagina with Viacutan (a 1% solution of silver dinaphthylmethane disulphonate) without any preliminary cleaning, followed by insufflations of acetarsol compound powder in non-pregnant cases, together with the use of acetarsol compound pessaries daily during the course of treatment.

In over 20 resistant cases of trichomonal vaginitis, all were found to be free from symptoms and signs of the condition after one course of this treatment and in none of the cases was relapse reported within 6 months. (*Brit. Med. J.*, 1950, i, 1116.)

Viacutan is supplied in bottles of 50, 100, 500 and 2,000 c.c.

Why doctors prescribe

EKAMMON

whenever aspirin or salicylates are required

- **EKAMMON** contains Vitamin K which counteracts the prothrombin reducing action of aspirin. (*J.A.M.A.*, 1944, 125, 546).
- **EKAMMON** contains Vitamin C, the excretion of which is accelerated by aspirin. (*Proc. Soc. Exp. Biol. Med.*, 1936, 35, 20).
- **EKAMMON** counteracts the Vitamin C deficiency usually present in patients suffering from rheumatoid arthritis. (*Proc. Soc. Exp. Biol. Med.*, 1936, 35, 347).
- **EKAMMON** is the salicylate of choice in rheumatism, arthritis and fibrositis.
- **EKAMMON** tablets each contain Aspirin 0.33 gm., Vitamin C (ascorbic acid 20 mgm.) and Vitamin K (menaphthone 0.33 mgm.).
- **EKAMMON** tablets are supplied in containers of 50, 100 and dispensing packs—500 and 1,000.

A 16- page Ekammon booklet, with an extensive bibliography, is available on request

WARD BLENKINSOP & CO. LTD.

6 HENRIETTA PLACE, LONDON, W.1 *Telephone: LANgham 3185*

Telegrams: Duochem, Wesdo, London

P.9.

When Constipation and Hyperacidity are concurrent —

— as they usually are ...

In the treatment of chronic constipation, particularly where it is associated with gastric hyperacidity, 'Mil-Par' provides a reliable antacid laxative of unvarying efficacy.

A balanced combination of 'Milk of Magnesia'* with a selected grade of medicinal paraffin, 'Mil-Par' neutralizes excess gastric acidity and checks the development of acid conditions in the lower alimentary tract. In the intestine, where it readily permeates the faecal mass, 'Mil-Par' softens the bowel content and provides both lubrication and gentle stimulation.

'Mil-Par' is specially to be recommended during convalescence after operation or protracted illness; for infants and children, expectant and nursing mothers.

'MIL-PAR'

REG'D.

ANTACID LUBRICANT

Available in 8 oz. and 16 oz. Bottles

The Chas. H. Phillips Chemical Co. Ltd.

1, WARPLE WAY, LONDON, W.3.

* *'Milk of Magnesia' is the trade mark of Phillips' preparation of magnesia*

'Sulphamezathine' in Pneumonia

"These observations confirm that 'Sulphamezathine' is highly satisfactory in lobar pneumonia . . . . . Its lower toxicity may help to reduce the mortality in very ill patients, while the virtual absence of vomiting ensures more complete absorption." See *Lancet*, 1944, *i*, 277.

"Of the commonly available sulphonamides, 'Sulphamezathine' causes relatively little nausea and vomiting and, having an acetyl derivative of high solubility, very rarely gives rise to renal complications. It is therefore suitable for routine treatment." See *British Medical Journal*, 1949, *ii*, 1225.

In Children: "The results of treatment with 'Sulphamezathine' therefore compare favourably—. . . . . showing the lowest mortality rate, the most rapid response to treatment and freedom from toxic effects." See *Arch. Dis. Childh.*, 1944, *19*, 122.

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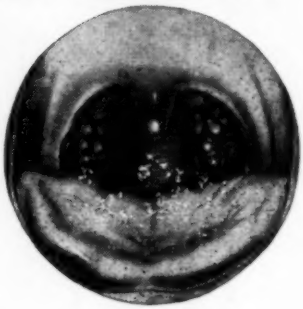

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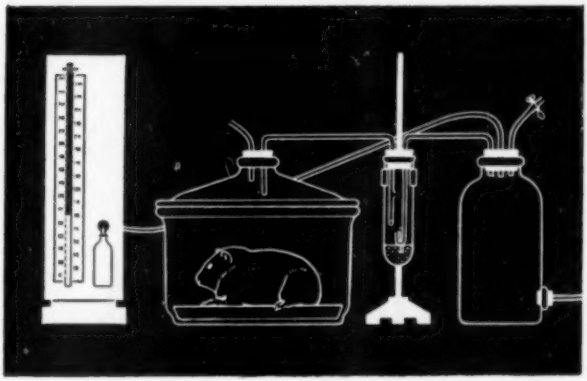

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Ammonium chloride	12 grs.	Menthol	1/10 gr.
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Dosage: Adults, 1-2 teaspoonfuls. Children, ½-1 teaspoonfull in water

Supplied in 4, 16, *and* 80 *fluid-ounce bottles.*

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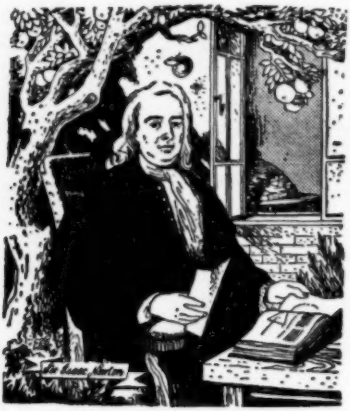

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THE TWO-IN-ONE ANTACID
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ACID REDUCTION
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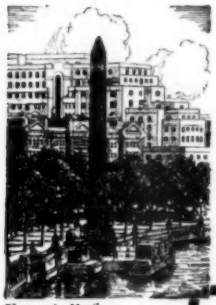

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THE PRACTITIONER

No. 990 DECEMBER 1950 Volume 165

THE MONTH

The Symposium

It is a curious commentary upon the speed with which scientific progress has outstripped moral progress that we should find it advisable to devote a symposium to the 'medical aspects of atomic warfare'. 'But Facts are chiels that winna ding, An downa be disputed', and as a profession it is facts with which we have to deal. Atomic warfare is now a certainty should another world war engulf us, and as doctors this involves us in a threefold duty. In the first place it is our duty to reassure those citizens who constitute our patients, and to maintain their morale. In the second place we must be able to play our part properly in the organization of those Civil Defence measures which must now be carried through to ensure that should the worst happen, then we as a nation shall be in the best possible position to deal with the situation. Thirdly, we must be as conversant as possible with the hazards of atomic warfare and how to deal with them, so that the victims of the atomic bomb will receive the very best treatment. The aim of this symposium is to provide our readers with the essential information on the hazards of the atomic bomb, the detailed plans which have been evolved to cope with it, and the treatment which can be applied to its victims. In preparing it we have been privileged to have the expert advice of Sir Ernest Rock Carling, and we take this opportunity of expressing our gratitude to him for all the advice and guidance which he has given us so willingly and ungrudgingly. It is our sincere hope, as it is of all our readers, that the information contained in this symposium will never need to be applied in practice. To ignore the present state of international affairs, however, would be unpardonable. As doctors, and as citizens of a great democracy, it is our duty to be in a position to calm the fears of our more apprehensive patients, and to be able to do our utmost to help them should civilization be engulfed in a world conflagration dominated by atomic weapons.

A Munificent Gift

The announcement that the trustees of the Wellcome Foundation have presented to the Royal Society of Medicine the sum of £80,000 'for the purpose of establishing within the Society a medical research library bearing the name of Wellcome which shall be effectively part of the Library of the Society' is a munificent recognition of the unique position which has been attained by the library of the Society. It is no criticism of the other activities of the Society to say that it owes a large part of its membership to the high standing of its library. In the extent of its contents and the scope

of its services it is universally recognized as the leading medical library in Great Britain and it will stand comparison with any other medical library in the world. Ever since the end of the 1939-45 war the council of the Society have found its expansion a source of considerable embarrassment, both financially and from the point of view of accommodation. This generous gift from the Wellcome Foundation should go far towards solving these problems, and the plans whereby the money will be utilized will be awaited with much interest. It is to be hoped that in considering these plans full attention will be given to the needs of non-London Fellows of the Society. There has been a tendency of recent years for Fellows in the provinces, and in Scotland and Wales, to feel that they are being neglected in comparison with their colleagues in London. Even though most universities have now a first-class medical library, this is never sufficient to meet the entire demands of research workers and senior members of the medical staff, and in planning the allocation of this new gift it should be possible to ensure that increased library facilities are made available to Fellows outside London and the home counties.

G.P.'s and R.S.M.

THE setting up of a Section of General Practice within the Royal Society of Medicine marks one of the most interesting developments in the history of the Society. According to the petition formally submitted to the Society in application for the formation of such a section, the objects are stated to be threefold: (1) to narrow the widening gap between specialists and general practitioners; (2) to provide for the general practitioner an active link with currently accepted ideas; (3) to keep alive the academic or scientific attitude to medicine and its allied branches which is so readily lost in general practice. These are all laudable objects and we wish the new section a long and successful career, but we do not envy the successful petitioners their task. Great care and tact will need to be exercised to ensure that the section does not fall between the Charybdis of being merely the audience for yet another lecture on recent advances or theoretical medicine by an enthusiastic vocally minded specialist, and the Scylla of being a happy hunting ground for those drones and oddities among general practitioners who like to hear their own voices and have little else to occupy their time. We have little doubt that the enthusiastic organizers of the section have carefully considered these risks, but we would beg of them to proceed cautiously in their plans. To talk about general practice as a specialty is one of those pert phrases which trip so temptingly off the modern tongue, but fundamentally general practice is not a specialty—it is the whole range of medicine, and to provide a syllabus for men of such wide interests is by no means easy. Then again, there is the distinct danger that the formation of a section of general practice may tend to isolate the general practitioner member of the Society from his specialist fellow-members. Will, for instance, the general practitioner learn more from a lecture on, say, the treatment of pneumonia, delivered to his section than

he would from listening to a discussion on this subject in the section of medicine? These are but a few of the problems which will need careful consideration by the sponsors of this new section if their plans, as we sincerely trust they will, are to attain real success.

Doctors' Samples

For some time an interesting correspondence has been going on in the *Journal of the American Medical Association* on the subject of free samples sent to practitioners by drug houses. The scale on which this is done in the United States is almost literally colossal. For instance, one physician found that in a six-months' period he had received forty-seven packages weighing a total of 6.9 pounds, and 357 'pieces of literature' weighing a total of 22.3 pounds. He estimated that on this scale the cost of postage alone for one year would be practically $20. The same correspondent also drew attention to the risk of young children picking up such packages dropped through the family letter-box, and sampling personally the elegant but potent preparations with 'certainly inconvenient if not disastrous results'. Another enterprising correspondent suggested that if the drug houses insisted on maintaining this deluge, then local medical societies should arrange to collect all such samples from doctors in their areas and send them to the Red Cross Society for distribution to destitute European and Asian countries or to charity wards in American hospitals. Although not practised on quite the same scale in Great Britain, this is a problem which deserves serious consideration by both doctors and the pharmaceutical companies in this country. Are the benefits ensuing from this practice to either producer or consumer at all commensurate with the cost?—and this includes not only the cost of the drug, but also postage, packaging and the man- and woman-power involved in the process How many doctors are simply irritated by the mass of advertising material that reaches them every day and immediately consign it to the waste-paper basket? After all, practically every pharmaceutical house of standing advertises in the medical press, and in the opinion of many practitioners this is the only source of information on medical products that they require. The problem, of course, is one primarily for the consideration of the pharmaceutical companies, but it might be well for them to review the whole subject and decide whether they might not be helping both themselves and their doctor customers by restricting this spate of postal advertising material.

Indigenous Herbs

The wise and experienced clinician never spurns an 'old wife's tale' until he has good evidence for doing so. The lore of the countryman is built upon the experience of generations—often of centuries—and the data upon which it is based have often been obtained at a price in human lives which no modern research worker would ever dream of considering. It is particularly appropriate at the present moment, when the pharmaceutical companies of the world are emitting an unceasing flow of new synthetic drugs, that attention should be

turned to the possible remedies that may be found among indigenous herbs of this and other countries. Four examples of such research proving fruitful may be recalled. In eastern Mediterranean countries and in Arabia the local physicians often prescribe a decoction of the dried seeds of a local plant, *Ammi visnaga*, as a diuretic and as an antispasmodic in renal colic. Investigations by G. V. Anrep and his colleagues in Cairo (*Brit. Heart J.*, 1946, **8,** 171) showed the active constituent to be khellin, which they found to be an effective vasodilator with a selective action on the coronary arteries. Subsequent clinical trials demonstrated the value of khellin in the treatment of angina pectoris. From ancient times the root of an indigenous plant, *Rauwolfia serpentina*, has been widely used in India and Malaya as an antidote to insect and snake bites, as a febrifuge, as a stimulant to uterine contraction, and as a sedative. R. J. Vakil (*Brit. Heart J.*, 1949, **11,** 350) investigated its use in hypertension and found it to have a marked hypotensive action.

Even in the currently popular field of the chemotherapy of tuberculosis, indigenous plants are proving of interest. Thus, Japanese workers have isolated from a vine named *Stephania cepharantha*, and from a wisteria-like plant named *S. sasakii*, the alkaloid cepharanthine which is being used for the treatment and the prophylaxis of tuberculosis in Japan (*Jap. J. exp. Med.*, 1949, **20,** 69). Chinese workers have been investigating the antituberculous activity of a series of local plants, and Virginia Wang (*Chinese med. J.*, 1950, **68,** 169) reports a 'prominent tuberculostatic activity' in extracts of Coptis root (*Coptis coinensia*), this activity apparently residing in its alkaloid, berberine sulphate. It is clear that much remains to be learned from a close study of indigenous herbs. It may well be that here lies one of the major contributions that countries such as China, India and Pakistan can make to the advancement of world health. Certainly, this tendency should be encouraged by their colleagues in the West. We in the West have learned much from the old cultures of the East. May it not be that the East can contribute much of value in yet another field—that of therapeutics?

G.B.S.

As members of the profession which he most loved to lampoon, it is only fitting that we should pay our tribute of respect to George Bernard Shaw. He was a unique combination of paradoxes. An Irishman who became the greatest English playwright since Shakespeare. A socialist who still remained the doughtiest exponent of individualism in living memory. A man who revelled in denigrating vaccination and vivisection, and yet owed the last twenty years of his life to the discoveries of the vivisectionists. There are few of us who did not fall under his spell some time or other during our younger days, and even when we attained full adult status and could no longer be taken in by many of his ingenuous ideas for reforming the world, we still revelled in his gift of repartee and mastery of the stage. Life will be dull without G.B.S., but we shall always be grateful to him for amusing and stimulating us so effectively.

MEDICAL ASPECTS OF ATOMIC WARFARE

MORALE

AN EXERCISE IN PREVENTIVE MEDICINE

By SIR ERNEST ROCK CARLING, F.R.C.P., F.R.C.S., F.F.R.

Consultant Adviser for Casualty Services to the Home Office and the Ministry of Health; Consulting Surgeon, Westminster Hospital.

'Courage, tout le monde! le diable est mort'.—Charles Reade.

To live in the atomic age is perforce to accept the implications; fully faced they are robbed of half their terrors.

The foul details of destruction by atomic bombs, or indeed by any weapons of mass destruction, are detestable to contemplate, but so are the bare horrors of flood, famine, pestilence and plague. Atomic bombs have within them potentialities for mass damage comparable in magnitude with great natural catastrophies. The spontaneous response to such 'natural' hazards is not passive acceptance, it is action for assistance and relief. For 'natural' disasters, only rarely can preparation be made, but for atomic disaster we can all prepare and, where the will is forthcoming, prepare successfully. Preparation is a potent deterrent of the employment of such weapons. Some competent authorities believe that Hitler did not use gas against the civil population of this country because he knew that everyone had been supplied with a respirator before September 3, 1939, and he knew that his own people were not so fully protected. A belligerent must ask 'Will the atomic bomb be worth while? Is the colossal expenditure of industrial potential and of money likely to earn an adequate return?' As regards at least one of its possible uses—to maim and kill civilians—the answer is, not if all men, women and children have learned their lessons, accepted their rôles, and become amenable to discipline'. That is a big order, but we are in a world of that order of compliance and must recognize it. It is a commonplace to say that our people will always face up to dangers about which they know. It is much more than a commonplace: it is a truth of which we have five full years of evidence. The greater the danger faced between 1939 and 1945, the better the proof offered. One element of it was repeatedly demonstrated. To have something definite to do under stress, something that men and women had trained themselves to do with competence, was to quell apprehension and banish unreasoning fear. This is not to say that people were not properly and proportionately frightened. Fright is one of the fundamental instincts, the basis of the structure and function of some of our organs: but controlled fear is a motive, not a weakness.

There was an exodus from a bombed town that looked rather like panic. When it was realized that 70,000 houses had been damaged; when it transpired that the men who had taken their families to what distant dwelling they could find returned to work, some in forty-eight hours, some in three days, some in a week, according to the distances they had had to wander to find the desired resting place; then it seemed clear that the driving force had been a natural human instinct, and not mere subjection to terror.

In the early morning after a famous city was attacked there streamed out women with their children and their possessions on prams and trucks and bicycles, just such a procession as in those distressing pictures of refugees on the Belgian and French roads, fleeing before the onset of the German armour in the early days of the war. But with a difference! These people were smiling, cheerful themselves and cheering on others. Why? They knew that a little farther on there were lorries waiting to take them to billets. There were field kitchens with hot food on the roadside. Preparations had been made: emergencies had been foreseen; the Civil Defence forces were proving their reliability. A bad business it was, yes, but one that could be faced and turned into an adventure.

Public morale demands just such confidence for its sustenance; confident knowledge of precisely what one should do, and of what not to do; confidence in the group to which one belongs and in its leadership; confidence in the Civil Defence organization; confidence in the armed Forces, and ultimately, confidence in the central Government, the guardians and exponents of the Nation's cause. There is an order of succession. Every individual must play his part; upon him his group depends; upon groups the trained forces can rely; and behind all must come a belief in a way of life for which it is worth while to risk life as well as limb.

SAFETY MEASURES

If a bomb drops *on* you, at least, as the French used to say, 'you can't worry any more'. But among the population a ton of H.E. in a bomb kills very few men. An atomic bomb used against an unprepared population would certainly produce a great number of casualties, but if the proper preventive measures were taken and the regulations observed the figures would be reduced by at least fifty per cent.

The walls of a row of houses are defence against the obliquely falling gamma rays. Shelters do very greatly reduce the danger from falling debris. For 'flash-burn' a mere minimum of protection is needed. It may be we shall have to resort once more to respirators, and it is satisfactory to know that the same mask which is efficient for gas, is also satisfactory for radioactive and other toxic dusts. Incidentally it would protect the face from flash-burn.

Safety will be chiefly in behaviour, and behaviour can be learned so thoroughly as to become instinctive. To be learned it must be taught, and practitioners, giving advice as they are every day, have an excellent opportunity to inculcate the right behaviour. Medical men are better able than others to appreciate the risks, and should know what can be done to avoid them or to mitigate their results. No one, perhaps, is in a better position to inculcate the right attitude of the people to danger. They have taught people

how to face the danger of diphtheria, and successfully encouraged them to take the measures necessary to escape it. If they failed in the case of smallpox it was because they had not brought home to the minds of the present generation the real menace. When smallpox came there was no difficulty over getting vaccination accepted. Now we are facing a danger more devastating than smallpox. An epidemic may come upon us unheralded; it calls therefore for immunization during times when the epidemic horizon is unclouded; so in the present 'peace', practitioners should be conditioning all those in their care to acceptance of instructions for defence and the safety of their dependants.

ATOMIC INJURIES

The gross injuries due to blast from an atomic bomb are of the same order of severity as those from H.E. They may be no more in number than those from an equivalent weight of other bombs, but there is this difference, that they occur all together in a very short space of time, a matter of seconds. This makes it imperative to have plans for medical treatment that are extremely flexible and thoroughly mobile. Massive attack bears very heavily upon public morale and demands highly disciplined action by civil defence troops on the spot, backed up by equally well-organized medical arrangements. It is certain that all medical and nursing personnel will be stretched to the utmost, and economy in their employment calls for very careful planning. It has often been a reproach that planners prepare for the last war not the next. Up to a point that is inevitable. The precise character of the attack with new weapons and new tactics cannot accurately be foreseen. Even if anticipated by military experts, for security reasons the information cannot always be divulged. All the same, two generations of medical men have met and surmounted such difficulties—better the last time than the first—and there is no reason to think that the next generation will not rise to the occasion similarly. If they are to do so they must have familiarity with all the types of injury they are likely to meet, as well as of the circumstances in which they will be called upon to treat them.

There is one danger, that of radiation of the gonads, with regard to which, apart from reiterating the sound principle of 'going to shelter', we can do little by way of prevention or treatment. Some chromosomes in the total gonadic mass of the population will be broken and will not reunite in line. Some genes will be eliminated or modified. It is perhaps not much consolation that for some of the adverse results to become statistically perceptible, centuries must pass. Premises chosen from observations on drosophila lead to the conclusion that well over ninety per cent. of mutations are disadvantageous. It is unlikely, geneticists say, that we shall be able to rejoice more over one beneficial modification than over the ninety and nine harmful. Those of us who are not geneticists may reflect that the lines of development of insects have diverged widely from those followed by human beings. It is

a very far cry from drosophila to man. With the evidence of palæontology before us and the knowledge that organic life has been exposed to irradiation, cosmic and terrestrial, throughout geological time, and, moreover, with the knowledge that a great number of organic molecules are toxic to chromosomes and must have been threatening and modifying them while life has existed, we may perhaps doubt whether everything is as gloomy as geneticists presage. In any event, all these noxious agents will continue to act upon mankind long after atomic bombs have become but relics of a barbarous past. Hitherto we have not worried about such things as the high dose of cosmic rays received by people living in high altitudes as compared with lowlanders, nor that some people throughout their lives drink water more radioactive than others. There is, so far as our information goes, no evidence that they contribute more defectives to the population. Heavy doses of radiation will kill: we know that; but such victims of today clearly cannot harm tomorrow's generations. It is the lightly irradiated who might be a genetic menace. Surviving Japanese, who for a time were sterile (but not impotent), have recovered, and it is difficult to detect any defect of fertility or increase of abnormalities among the present offspring. We cannot yet tell about recessives.

Genetic hazards must be judged along with all the other chances of man's day-to-day existence—from disease, from accident, from mass-malnutrition and from economic pressure—which have dogged his footsteps since he left the Garden of Eden. It is the duty of doctors to protect their patients, and all who might be patients, from scaremongers and mental adolescents who would make our flesh creep. We should keep a sense of proportion even about so speculative a subject as human genetics.

CONCLUSION

Most medical men of today know from personal experience how vital to the morale of an army, or of its several units, is an efficient medical service. The same in even greater degree holds good of a whole population exposed to warlike attack.

It is as yet too early to set out the whole plan of medical defence, which will no doubt be made public as soon as policy permits. Whatever it be it will impose upon doctors, as upon the people at large, duties and sacrifices not easily to be borne—but the stake is tremendous. The life of the Nation and indeed the persistence of civilization as we know it may be in jeopardy.

Prevention is ultimately a matter of discipline. The medical profession has as its job the inculcation of self-help, sensible conduct, and willing obedience. In any event there will unfortunately be so many 'cases' demanding treatment that the resources of man-woman-power will scarcely suffice, even with effort to the borders of endurance. The burden must be diminished by education of the public, and that education should be pursued with unrelenting assiduity and patience.

A SIMPLIFIED ACCOUNT OF ATOMIC RADIATION PHYSICS

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An atomic explosion is of medical significance in that it is a source of thermal, visible and ultra-violet radiations; it creates blast, and it is a source of ionizing radiations. The relative importance of these factors depends considerably upon the circumstances of the explosion, as for example, a high-air burst (few thousand feet), a near-ground burst, or an underwater burst. The intense heat developed at the moment of explosion corresponds to an energy of the order of one hundred million kilowatt hours, and the initial temperature at the centre is in the region of a million degrees centigrade. The intense ultra-violet, visible, and infra-red radiations in the first second or so can cause serious burns and fires at distances up to a few thousand yards in the open. The penetrating power of this radiation through solid objects, even clothing, is low, and consequently it is only effective over a wide area when the explosion takes place well clear of obstructions on the ground, as in the high-air burst. Similar intense local heating in the explosion produces a powerful blast wave of unusually long duration. These thermal and blast effects might be simulated partially, though not completely, in the explosion of many tens of thousands of tons of conventional high explosive. Thus, although the most dangerous potentialities of the explosion arise through these effects, the injuries resulting are of a type already experienced in other fields. The emission of ionizing radiation on the other hand and the type of injury produced are features of the explosion which, though not first in order of importance, are novel in character and therefore require special mention.

THE NATURE OF IONIZING RADIATION

The energies involved when an atom or molecule absorbs or emits thermal or optical radiation or takes part in a chemical reaction are at most a few electron volts,* corresponding to comparatively minor rearrangements of the planetary electrons in the outer atom. The energies involved in ionization are about ten times greater, corresponding to the complete freeing of an electron from the atom, leaving a positively charged ion; the electron may attach itself to some other atom or molecule with the formation of a negatively charged ion. The initial disturbance of the atom or molecule in the process of ionization and in the eventual recombination of the ions, together

*One electron volt is the energy imparted to an electron in passing through a potential difference of one volt.

with the reactive properties of the ions, can lead to profound chemical changes which are believed to be the initiating cause of the biological effects of ionizing radiation. This concept underlies the term 'dose of ionizing radiation'.

The lifetime of the ions in a liquid or a solid is extremely short but in a gas it is comparatively long, and if electrodes are present the ions may be completely collected; the continuous current is then a measure of the rate of production of ions. It is not normally practicable to measure the degree of ionization in a medium other than a gas, but means are available for determining a related quantity, the amount of energy absorbed per unit mass. This quantity, normally expressed in ergs per gramme, is the basic physical measure of dose for all ionizing radiations. A more particular definition of dose was evolved historically for X-rays and gamma rays in terms of ionization in air, because the mode of interaction of these radiations with the atoms of air and of living tissue is closely similar, and hence the ionization in air is closely parallel to the energy absorption in tissue. The unit of measurement, the rœntgen, corresponds to that number of ions of either sign equivalent to one electrostatic unit of charge per c.cm. of air at standard temperature and pressure. A dose of 1 rœntgen corresponds to an energy absorption of about 93 ergs per gramme of tissue. The energy absorption for other radiations, notably neutrons for which air ionization is a quite unsuitable measure of dose, is commonly expressed in units of 93 ergs per gramme, to which the name 'rœntgen equivalent physical' or 'rep' is given. The biological effect of an ionizing radiation is not uniquely correlated with the physical dose, and a further factor of relative biological efficiency has to be associated with a given radiation. It may be noted in passing that the properties of ionizing radiations responsible for their biological effects, namely, the production of ions (leading to an electrical current in a gas) and consequent chemical change (blackening of photographic film, change of colour of crystals) can be utilized in the detection and measurement of the radiations for monitoring purposes.

Ionizing radiation arises from an atomic explosion in several ways, and includes neutrons, gamma rays and beta rays. The explosion itself is a direct source of radiation, and in addition, radioactive substances are produced which emit further ionizing radiation. Thus the body may be exposed to radiation externally and also internally if the radioactive substances enter the body owing to the contamination of air, drinking water or food.

NEUTRON RADIATION

Most of the energy of the explosion appears in the instantaneous production of heat locally, with consequent intense thermal radiation of short duration —the heat-flash. At the same time, a small percentage of the energy appears as fast neutron radiation, of such intensity that exposure at distances up to about a thousand feet would of itself prove fatal. Neutrons have great pene-

trating power, and so could constitute a serious danger even if protection against flash-burn and blast had been obtained. In the vast majority of situations likely to arise in practice, however, the penetration of the gamma radiation and danger therefrom overshadow the neutron danger.

The neutrons in traversing matter undergo numerous 'billiard ball' collisions with the atomic nuclei, so that their energy is rapidly reduced from its initial value of a few million electron volts to the ordinary kinetic energy of thermal agitation, i.e., a fraction of an electron volt. There is then a considerable chance that a neutron will be captured by a nucleus with the formation of a radioactive isotope, itself constituting a source of ionizing radiation in the form of beta rays and gamma rays. The radioactivity from the fission products would in nearly every set of circumstances far outweigh this neutron-induced activity, and in particular the direct activation of food by neutrons, even in the lethal zone of radiation, seems unimportant. An under-sea burst could result in the production of appreciable quantities of radioactive sodium, Na^{24}, but the possible danger therefrom would depend greatly upon the precise conditions, and would normally be of secondary importance. Lastly, the neutron radiation is emitted as an instantaneous flash and so no question arises of monitoring for residual neutron radiation after the explosion.

GAMMA RADIATION

The most important ionizing radiation from the atomic explosion is the gamma radiation, some of which arises at the instant of explosion itself and some from the radioactivity of the nuclei which represent the fragments into which the uranium or plutonium nuclei split. The primary fission fragments contain too many neutrons for nuclear stability, and so a readjustment occurs, first by the almost instantaneous emission of one or two neutrons, referred to above, and then by successive transitions within the nucleus of neutrons into proton states. In other words, the primary fission fragment, after losing one or two neutrons, passes through a series of radioactive changes transforming from one isotope to the next with the emission of beta rays and gamma rays, until a stable isotope is reached; these isotopes are called fission products. An unstable nucleus has a certain definite probability of undergoing a radioactive change in any one instant, and consequently a definite fraction of a collection of such nuclei will change in each unit of time. This behaviour is expressed mathematically by the exponential law of decay. The time for half the nuclei to undergo change is a characteristic of that particular nuclear species and is known as the radioactive half life. The activity of a given sample of radioactive material is measured in terms of the number of nuclei transforming per unit time. The unit of activity is the curie, representing 3.7×10^{10} disintegrations per second, which is approximately the activity of one gramme of radium. In an atomic explosion, something like a million million curies of mixed radio-

activity are produced; the total energy emitted in the subsequent radiations is roughly one-tenth that in the explosion as a whole. As the transformation of the fission products to less unstable nuclear forms proceeds, there is a rapid decrease in the rate of change. Thus the initial activity of one million million curies falls to six thousand million after one hour, to about one hundred and thirty million after one day, to thirteen million after one week, and to one hundred thousand after one year.

The most notable gamma ray emission associated with the explosion comes from the explosion itself and the highly unstable fission products in about the first ten seconds. After that time, with a high-air burst, nearly all the radioactivity is carried by the cloud of hot gases too far upwards in the atmosphere to be of immediate importance. The beta rays emitted by the fission products come to rest completely after passing through a few yards of air, but the gamma rays are highly penetrating. The intensity falls off with distance from the burst because of the inverse square law and because of true attenuation, due to encounters between the rays and the atoms of air or other medium. This attenuation does not follow a simple exponential law, because of the fact that in addition to true absorption of the rays in atoms, scattering with only partial energy loss also takes place. The attenuating power of a medium is dependent upon its density and upon the atomic composition. Heavy atoms are much better absorbers than light atoms. Thus, the point at which the dose produces a 50 per cent. mortality is rather more than 4000 feet from the centre in open air; but some 20 inches of concrete, or alternatively 33 inches of soil, would reduce the dose at this point to a harmless level.

FISSION PRODUCTS AND CONTAMINATION

The importance of the fission products after the first few seconds depends greatly upon the particular circumstances. In the high-air burst, there is a good chance of their being completely removed from the scene and dispersed safely, but there is a possibility that appreciable amounts could be carried down by rain and constitute some danger. This mechanism is known as 'fall-out', but a more serious possibility of contamination arises from a ground burst or an under-water burst, when a large proportion of the fission products may be spread over a considerable area in dust, mud or spray. There is also the possibility of the use of fission products produced in an atomic pile as a primary weapon. There are two distinct aspects to this type of risk, namely, external irradiation and the ingestion and inhalation of active material leading to irradiation of internal organs. If the one million million curies of radioactivity (corresponding approximately to the initial activity of the fission products of an explosion) were uniformly spread over a flat ground area of one square mile, the dose received by a man would be a few hundred rœntgens per day. Much lower levels of contamination could easily be measured by simple devices in the field. The dose

rate from any contamination immediately following an explosion would fall by a very large factor in the first twenty-four hours. The question of ingestion and inhalation of active material is of particular importance for a long-term assessment. Some of the fission products have long half-lives, and further, they localize in certain organs and are retained; the resulting chronic irradiation may produce serious pathological changes. Standards now exist for safe levels of activity in air and in drinking water, which would serve as one base line in the assessment of the hazard in a particular set of circumstances.

CONCLUSION

It is thus apparent that only for the high-air burst explosion is the physical problem of the ionizing radiation fairly simple and straightforward. The effects are accomplished with finality in a matter of seconds, and they are distributed according to a fairly regular pattern of decreasing effectiveness with distance. In a ground or under-water burst, although the total casualties may well be fewer, the physical problem of ionizing radiation is rather more complex because of the indefiniteness of the situation and because of the persistence of some radiation. The radiation would not be expected to follow a regular distribution pattern, owing to the shielding importance of variations in contour and of buildings. In such circumstances, adequate monitoring of the area is necessary before a clear assessment of the radiation problem is possible.

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THE ACTION OF RADIATION ON THE TISSUES

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THE results of radiotherapy are familiar, and in principle the effects of radiation on tissue are very similar. The direct effects are always injurious. Individual cells may be killed, they may be damaged but recover completely, or they may be left permanently abnormal. For example, radiation can produce loss of hair from the skin. Subsequently the hair may never reappear or, if it grows again, it may appear normal or may be permanently depigmented. The consequences to the body's economy of radiation damage depend upon which cells and tissues are affected, i.e., upon the localization of the damage. Radiotherapy is deliberately applied so as to produce selective damage to unwanted cells with the minimum of permanent abnormality in normal tissue. For different reasons unwanted radiation from an atomic explosion also produces selective damage, depending upon a number of interrelated physical and metabolic factors.

WHOLE-BODY IRRADIATION

In the moments following an atomic explosion radiation gains entry to the body from outside and is of a penetrating type (gamma rays and neutrons). The whole body is irradiated but some tissues are much more sensitive than others and are therefore preferentially damaged. The most sensitive are the bone marrow and lymph nodes, followed by the gastro-intestinal tract, the germinal epithelium of testis and ovary, and the skin. Connective tissue, muscle and nerve cells are relatively insensitive, as is the peripheral blood within the blood vessels.

The syndrome of acute radiation sickness which occurs a few hours after whole-body irradiation has not yet been explained pathologically, but the subsequent evolution of the clinical picture seems to depend directly upon the damage to the radiosensitive tissues. The time-lag before symptoms and signs appear is because cell death by itself does not necessarily produce systemic ill-effects; compare, for example, dry gangrene. The death of precursor cells, however, will reduce or prevent altogether the normal continuous supply of new cells. As the leucocytes, red cells and platelets die or are removed from the blood stream there will be few or no replacements from the marrow and lymph nodes. Lymphocytes and neutrophil leucocytes have a short natural life of a few hours to days, and are thus the first elements in the blood count to be reduced in number. The greatly increased susceptibility to infection in the weeks following exposure to whole-body irradiation

would seem to be, at least in part, a consequence of the loss in production of leucocytes, e.g., the infections of mucous membranes seen in the Japanese were similar to agranulocytic angina. Other factors contribute to the liability to infection, including, presumably, the diminished ability to produce antibodies, the mechanism of which is not yet understood.

Red cells have a long natural lifespan of over 100 days. Anæmia therefore develops late, from the third week on, and infection and loss of blood from hæmorrhage and ulceration may be as important a cause as an aplastic marrow.

If cells are not killed but damaged, the normal rate of cell proliferation is greatly reduced. Surface structures like skin and mucous membrane epithelium are no longer able to renew themselves as they normally do. Ulceration and bacterial invasion ensue.

The hypothesis that the clinical picture of whole-body irradiation can be explained as the consequence of a deficiency of production of new cells is almost certainly incomplete, although efforts to demonstrate a circulating toxin have so far proved inconclusive. Hæmorrhage, for instance, a characteristic symptom in the third and fourth weeks after irradiation, is not completely accounted for by a deficiency in platelets. Circulating anticoagulants, too, are not of fundamental importance. The small blood vessels suffer from radiation damage in a manner unknown, and some defect in them contributes to the hæmorrhages, together with the general effects of infection and malnutrition.

After local radiotherapy, when the dose of radiation is of the order of ten times the lethal dose for whole-body irradiation, the reaction of the blood vessels is pronounced. Their endothelium swells, thrombi form, and eventually there may be complete occlusion of the lumen. In such circumstances fibrosis and scarring may be expected. The vascular reaction after whole-body irradiation is less pronounced because the doses required for vascular occlusion are such that their application to the whole body would lead to death in a very few days and before the reaction had time to develop.

RECOVERY

The destructive effects of whole-body irradiation in the lethal range are not absolutely complete. Even in the most sensitive organs some cells survive and after a time begin to multiply and reconstitute the affected tissue. In a protected situation like the bone marrow the original cells are replaced by a gelatinous material which can in turn be replaced by the newly multiplying stem cells. If the subject survives, the bone marrow will eventually return to normal, so that one aim of treatment is to tide the patient over this critical recovery period. In a superficial situation, on the skin or mucous membranes, ulceration and infection may occur and lead to scarring and incomplete restitution, but the main difference from local radiotherapy is still obvious. Here the higher doses used are designed to produce complete cell death, and

hence are likely to be followed by fibrosis and scarring if the area treated is of any size.

DELAYED EFFECTS

Radiation of any kind is able to cause neoplasia after a long latent interval, as in the early martyrs of X-ray development. Figures have been produced to show that deaths from leukæmia among medical men regularly exposed to radiation in the course of their daily work were ten times as numerous as those in other practitioners. Continued irradiation over a lengthy period seems to be an important factor in the production of neoplasms. The likelihood of their occurrence years after a single sublethal exposure to whole-body irradiation is quite unknown but is probably very small.

Extensive surveys four years after the two atomic bomb explosions in Japan have not shown any relapses or delayed effects, with one exception. The lens opacities which are now appearing in a small proportion of the survivors are believed to be radiation cataracts, but the relative causal importance of the ultra-violet irradiation, the infra-red irradiation, gamma rays and neutrons is unknown.

THE TOXICITY OF RADIOACTIVE ELEMENTS

The 'fission products' produced in an atomic explosion are normally dispersed by the violence of the explosion through a large volume of air or water. It will only be in exceptional circumstances that they will be sufficiently concentrated to be a danger to health. The dangers will then be those of inhalation and ingestion, for considerably larger concentrations are needed to do damage through the unbroken skin. Similar dangers will arise if fission products are ever used as poison gases or in 'ordinary' shells.

If radioactive materials do find their way into the body, either by absorption from the gut or by inhalation, the localization of radiation damage depends upon the metabolic behaviour of the material. A familiar example is iodine, which is normally concentrated in the thyroid gland. Radioactive iodine is similarly localized. Radioactive strontium, on the other hand, is laid down principally in the bones, because strontium is chemically very like calcium and is treated similarly by the body. In general, elements which are laid down in bone tend to stay there, whereas elements laid down in soft tissue are usually excreted more or less rapidly. Some long-lived fission products will thus produce continued localized irradiation of bone, and in such circumstances the main danger is the occurrence after a long latent interval of bone sarcoma and radiation osteitis. Contamination of cuts and abrasions of the skin and inhalation of radioactive dust may also lead to local tumour formation if insoluble elements like plutonium are concerned. But this is also unlikely, except in special circumstances.

THE MECHANISM BY WHICH RADIATION DAMAGES TISSUES

The intimate mechanism by which cells are affected by radiation has been,

and still is, the subject of intensive investigation, but there are wide gaps in our knowledge.

No qualitative difference has yet been found between the biological effects of different kinds of radiation, and on physical grounds such differences would not be expected. It is still uncertain whether in the living body radiation acts through the intermediary of altered water molecules or directly by hitting and damaging a molecular target. The most sensitive parts of cells seem to be the chromosomes, but chromosome damage is not a direct explanation of cell death or even of the induction of cancer. In the intact organism there is every possibility that some circulating poison is produced by the chemical action of radiation, but efforts to demonstrate this have been unsuccessful. Thus no treatment to neutralize the proximate cause of radiation damage has been found, and there is no prophylactic drug under the protection of which radiation can be received without any damaging effect.

It is also difficult to explain the differing radiosensitivity of different tissues and cells. It was believed at one time that the more primitive and the less differentiated the cell the more vulnerable it was to radiation, but this cannot be wholly true, because in the bone marrow, for example, the cells which survive and repopulate the empty marrow spaces are the most primitive ones. Another generalization of no greater validity is that cells are increasingly sensitive the smaller the amount of their cytoplasm as compared with the volume of the nucleus. Tissues which are rapidly developing are usually radiosensitive, so that the fœtus is more vulnerable than the adult.

Mammals are much more sensitive to radiation than birds, amphibia or fish, and lowly forms of life including bacteria and viruses are much more resistant still. Experimental work (with one or two exceptions when the experimental conditions have been so artificial as to render the relevance of the results doubtful) has so far failed to reveal any isolated cell constituent, such as an enzyme, which is as radiosensitive as the whole mammal.

Many metabolic investigations have been made after whole-body irradiation. There is a marked loss in weight, which is greater than can be accounted for by the anorexia and reduced fluid intake. Terminally, there is an increased urinary output of nitrogenous substances. The 'adaptation syndrome' of Selye may well be part of the whole picture. In a complex organism like man every organ is affected directly or indirectly by every other, and the slow evolution of radiation damage, as compared, for instance, with the shock which follows so soon after severe mechanical trauma, gives the maximum opportunity for such interlocking reactions to occur. Whole-body irradiation, too, is a sort of shot-gun which peppers every cell in the body. It is therefore perhaps not surprising that as yet so little is known about the mechanism of production of the syndromes that follow irradiation.

MORBID ANATOMY OF IRRADIATION INJURIES

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Available information on this subject is primarily based on American and Japanese reports of material examined after the atomic explosions at Hiroshima and Nagasaki. It is not known whether explosions under different conditions or of other types of bombs would produce analogous findings. Comprehensive accounts of the subject, which have been consulted and quoted freely, are given in 'The Pathology of Atom Bomb Casualties' (Liebow, *et al.*, 1949), 'Atomic Medicine' (Behrens, 1949), and 'Histopathology of Irradiation' (Bloom, 1948); the last named also discusses the effects of irradiation on animals. There have also been numerous reports of radiation pathology since the early years of this century.

As a result of an atomic bomb explosion, irradiation injuries may be due to the emission of intense thermal radiations, ranging from infra-red to ultra-violet rays acting over an extremely brief period of time, and ionizing radiation—gamma rays and neutrons.

INJURIES DUE TO THERMAL RADIATION

Flash-burns occurring at the time of explosion are peculiar to atomic warfare and were extremely common in the exposed population in Japan. Thermal radiations caused injury to exposed skin up to a distance of 4000 yards from the epicentre. Beyond 3000 yards, simple erythemas occurred with the occasional formation of small vesicles, as seen in cases of sunburn. At less than 2000 yards, burns were severe, and people close to the bomb suffered searing and charring to the depth of the subcutaneous tissues. It has been estimated that 95 per cent. of those directly exposed within 1,200 yards from the epicentre, died. Beyond this range, clothes afforded some protection. Between 1,500 and 3000 yards, burns of varying degrees of severity were encountered. At less than 2000 yards they were severe. Serious contact burns were caused by superheating and ignition of the clothing at ranges of less than one mile. Loose fitting, light coloured clothing seemed to offer some protection against flash-burns to Japanese wearers. Depigmentation occurred among cases in the vicinity of 2000 yards after the initial phase of erythema and blistering, even when there was no damage or only superficial damage to the epithelium. Beyond this distance the opposite effect was noted, and hyperpigmentation, resembling deep sunburning, occurred after the initial erythema. Many burns were followed by keloid changes. It is possible that poor treatment and infection had some bearing on this problem.

Pathological findings.—Histologically, there is confirmation of the clinical

observation that depigmentation can occur even when the epithelium is not completely destroyed, and that at the margins of the depigmented zones there are narrow bands of increased pigmentation. Deep to the burn an œdema fluid is observed, containing myxomatous material. Some proliferation of fibroblasts occurs, and macrophages are sometimes seen infiltrating the tissue. The picture can be complicated later by radiation effects, which result in aplastic anæmia with subsequent infection and hæmorrhages. In these cases there is a marked diminution in cellular reaction, granulocytes being absent or scanty.

INJURIES DUE TO IONIZING RADIATION

Unlike the thermal radiations, gamma rays and neutrons are highly penetrating, and within their effective range cause marked damage to sensitive tissues. Clothing is not an effective shield. All tissues are simultaneously injured to a varying degree in acute total body irradiation. Tullis (1949) states that the morbid and anatomical lesions of total body exposure to large doses of ionizing radiation fall into three main categories—tissue necrosis, multiple hæmorrhages, and secondary infection.

Tissue necrosis.—The primary effect of irradiation is the production of cellular injury. Recovery is possible, but if the injury is extensive, necrosis occurs. Although no tissue is entirely immune there are marked differences in the sensitivity of different tissues. The hæmopoietic system, lymphoid tissues and immature germ cells are among the most radiosensitive, whilst the highly differentiated tissues, such as bone, nerve and muscle, are more radioresistant.

Hæmorrhage occurs in all parts of the body and is probably the result of a combination of increased capillary permeability, possibly the presence in the blood stream in some cases of an anticoagulant substance, and thrombocytopenia. In addition, bleeding from ulcerations in the alimentary and urinary tracts leads to considerable blood loss. Other factors in the production of pathological lesions—anæmia, agranulocytosis, possibly toxæmia resulting from the accumulation of tissue breakdown products or absorption of these substances or other agents from the intestinal tract, and possibly some interference with the antibody mechanism—act jointly to lower the resistance of the body to disease.

Secondary infections are natural sequelæ to agranulocytosis. Hæmorrhagic agranulocytic necrotizing pneumonias were commonly seen in the Japanese about two weeks after irradiation; they also often developed multiple skin abscesses.

MORTALITY CLASSIFICATION

Liebow, *et al.* (1949) point out that signs of serious radiation injury were rare beyond 1,500 yards, if they existed at all, and stress that the character of the lesions was dependent upon the date of death, shielding and distance from the bomb, and the presence or absence of severe thermal or mechanical injury. Patients are divided into four groups:—

Group I: Patients dying in the first two weeks.—In this early group there was already histological evidence of radiation effect upon the hair follicles, gastro-intestinal tract, lymphoid tissues, bone marrow and gonads. But neither epilation nor purpura was clinically obvious in the vast majority of patients, as death ensued before these could be expected to appear.

Group II: Patients dying in the third, fourth, fifth and sixth weeks, or surviving severe clinical symptoms.—Not only were clinical symptoms of direct damage by radiation, such as epilation, present, but there were signs of aplastic anæmia resulting from the damage to the bone marrow. Secondary bacterial infection was as usual responsible for the necrotic lesions complicating aplastic anæmia. Purpura was now a frequent sign. Patients in this group had apparently recovered from the early effects, and there was a complete remission of symptoms until the appearance of epilation some two weeks after the bombing. About five days later a step-ladder-like pyrexia accompanied by increasing malaise began. This was followed by the appearance of petechiæ and ulcerative lesions of the skin, lips, mouth and pharynx. At the height of the illness patients showed symptoms of an ulcerative gastro-enteritis. Leucocytes and platelets reached very low levels at the time of the onset of pyrexia.

Group III: Patients dying after the sixth week.—In some patients the bone marrow failed to recover or exhibited a maturation defect: the previous symptoms continued and patients died after chronic illness. More commonly in the late deaths the marrow tended to recover towards the end of the sixth week, and with this recovery, the characteristic signs of aplastic anæmia, such as purpura, disappeared, but patients died of pneumonitis or enteritis: either a new illness of sudden onset or an exacerbation of a smouldering lesion which had started in the leucopenic phase.

Group IV: Mild cases.—Leucopenia was discovered in some asymptomatic cases during a routine check. These cases occurred among individuals who were situated near the limit of the range of radiation or who, although close, were shielded by heavy buildings. Diarrhœa was a common complaint. Others had mild or even severe epilation without other symptoms.

SPECIFIC LESIONS

The bone marrow.—Heavy doses of total body irradiation produce an effect on the bone marrow which is detectable microscopically within a few hours of exposure. Among the early changes noted are dilatation of the sinusoids and some necrosis, including karyorrhexis of the nuclei. All types of hæmopoietic cells are involved but the 'blast' cells are the most radiosensitive. Damage becomes extensive within two weeks; there is almost complete disappearance of blood-forming elements except in small islands. At this time the marrow appears red as if it were hyperplastic, but on microscopic examination hyperæmia in the aplastic marrow is found to be the cause of the redness seen macroscopically. If death does not supervene immediately, recovery of the marrow begins before the fourth week after exposure, and

by the sixth week a hyperplastic marrow may be found. If there is adequate marrow regeneration, recovery may occur, provided secondary infections do not arise. However, if the marrow remains aplastic for as long as six weeks, death almost invariably takes place.

The lymph nodes.—Lymphocytes are the most radiosensitive cells in the body, and therefore these cells begin to disappear shortly after exposure and their numbers fall rapidly. Atrophic changes are seen from the third day onwards with disappearance of the germinal centres of the lymph follicles. By the end of seven days, œdema and gross hæmorrhages are present in the pulp. Microscopically the sinuses are dilated and contain numerous macrophages. Lymph nodes in all regions of the body are involved to a greater or lesser degree, but the cervical, mediastinal, aortic and mesenteric nodes show the most extensive changes. The histological picture may later become confused as a result of the occurrence of lesions in other parts of the body, particularly pneumonia, abscesses, oral and gastro-intestinal ulcerations. In most cases, however, the hæmorrhage, œdema, and at least partial lymphocyte depletion, persist for weeks.

The spleen.—Macroscopically, the spleen is about normal in size and shape, and on section is dark red and firm. Microscopically, the sinuses may be slightly dilated or engorged. Deposition of blood pigment is in excess of that normally found. The malpighian corpuscles are indistinct, chiefly due to the depletion in lymphocytes; this occurs in much the same manner as in the lymph nodes, but to a lesser degree and after a longer time. Atypical, large multi-nucleated cells may be present.

Other lymphoid tissue.—The thymus, tonsils and Peyer's patches in the bowel also show a marked and rapid cellular depletion similar to that seen in the lymph nodes but, as in the spleen, the reaction is not as marked nor as rapid. Regeneration apparently does not begin so soon after injury, nor is it so complete. Petechial hæmorrhages are often observed in these organs.

The mouth and the pharynx.—The gum margins, pharynx, and tonsils are favourite sites for shallow, ragged, spreading ulcers. The necrotic bases of the lesions contain considerable cellular debris but few if any inflammatory cells, except when the lesion develops late. If the patient lives for four or five weeks following irradiation, and the hæmopoietic tissues are regenerated, there may be some cellular response. Although the ulcers are not well walled-off with fibrous tissue, they do not usually penetrate deeper than the submucous layer.

The gastro-intestinal tract.—This shows gross lesions early, and vascular damage results in hæmorrhages varying from multiple to massive petechiæ. Marked engorgement appears in the mucous membrane within one or two days after exposure. The cells of the stomach and intestine, particularly those in the submucous and subperitoneal layers, become œdematous. Hæmorrhages and œdema may occur in any part of the gastro-intestinal tract.

Ulcerations of the mucosa may also occur anywhere but are more likely in

the large bowel and stomach. These usually do not extend beyond the submucosal or muscular layers, and do not perforate. The margins of the ulcers are ragged and irregular. The hæmorrhagic necrotic base may be covered with a thick adherent fibrinous membrane, often greenish in colour. The intestinal ulcers tend to be elongated and in the longitudinal axis of the bowel. The stomach ulcers are elevated and have circular margins.

Microscopically the bases of the early ulcers show almost no cellular infiltration, but after four to six weeks a few granulocytes are present. Another characteristic change arises in the connective tissue cells in the submucosa about four weeks later: fibroblasts assume bizarre and often triangular shapes, are larger than normal, contain two or three nuclei, and their cytoplasm is hyperchromic. The muscle fibres are generally not involved and the muscular stroma contains a few scattered hæmorrhages only.

THE GENITO-URINARY SYSTEM

The gonads.—The testis and to a lesser extent the ovary are among the more radiosensitive organs in the body.

Macroscopically, multiple petechial hæmorrhages are scattered throughout the interstitial tissue of the *testis* and may be extensive, imparting a diffuse red colour to the organ. Œdema during this period may cause slight enlargement; the testes may later atrophy, becoming small, firm and fibrotic. Microscopically there is marked injury to the germinal epithelium, numerous cells of which are necrotic, and therefore in the tubules there are few spermatogonia; Sertoli cells, however, are apparently increased in number. Mature spermatozoa are found even when there is no spermatogenesis—apparently mature spermatozoa and Sertoli cells are radioresistant.

Changes in the *ovaries* are less striking. Macroscopically there may be no changes, but occasionally there are a few scattered hæmorrhages. Histologically, Liebow (1949) states that a few primary follicles show atresia. Usually, developing follicles are absent, despite the persistence of primary follicles. The endometrium shows an absence of corpus luteum effect.

The urinary tract.—Hæmorrhagic manifestations are in the form of primary lesions in the kidneys and ureters. In this stage mucosal hæmorrhages in the bladder may result in necrotizing ulcerations without evidence of leucocytic infiltration. Blood clots are often found in the pelvis of the kidney and in the bladder at autopsy.

The adrenals.—Various observers (Tullis, 1949) have noted the loss of lipoid material in the Japanese cases. Histologically there may be scattered hæmorrhages, usually very small, in the cortex or medulla. Necrosis is seldom seen. Occasionally small foci of necrosis may be present, but no characteristic lesions are observed.

The heart.—Epicardial petechiæ are present within the first two weeks, and there is microscopic evidence of perivascular œdema in the myocardium, but the muscle fibres themselves appear normal. Signs of myocardial hæmorrhage are found during the first two months. These distinct irradia-

tion changes are rare. The pericardial sac may contain a slight excess of free fluid.

The lungs almost always show signs of injury following total body irradiation. The chief characteristics of the lesions are their variability in different parts of the lung and the marked diminution of cellular response. The alveoli may be aerated but more often contain serous or coagulated fluid, numerous erythrocytes, and a few macrophages. A hæmorrhagic, necrotizing pneumonia may occur within two weeks after the LD_{50} dose.

The pituitary.—Large basophilic cells appear in males dying in the third to sixth weeks. Because cells of this type were found in mammals after castration they are referred to as castration cells.

The skin.—Epilation of the scalp in the Japanese cases began about the second week after irradiation. Loss of hair of the axillæ, beard, pubis and eyebrows follows in that order, but occurs much less commonly. Atrophy of the hair follicles takes place, and is accompanied by loss of definition and merging of the epithelial layers around the shaft. Regeneration of some of the follicles begins about three months after irradiation, but the process is extremely slow and may extend over months or years.

Miscellaneous.—Only secondary hæmorrhagic or necrotic changes are found in the *brain*. No changes are noted in the *pancreas*.

RADIOACTIVITY WITHIN THE BODY

Radioactive material may be absorbed into the body by inhalation, ingestion, or through injured skin surfaces. The most serious results occur through localization in bone. These include damage to the marrow, pathological fractures, and malignant changes. The occurrence of radioactivity within the body does not present a new problem. The condition was recognized from 1920 onwards in cases which occurred in radium dial painters (Martland, 1931), and in uranium miners in the Joachimstahl mines in Czechoslovakia (Peller, 1939). Pathological findings in the former included blood dyscrasiæ, necrosis of the jaw and other bones, frequent fractures and delayed union, osteogenic sarcomas and fibrosarcomas. In the latter, between 1929 and 1938, deaths were often due to intrathoracic carcinoma. Lisco, *et al.* (1947) have produced carcinoma of the colon in animals given radioactive Yttrium by mouth.

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RADIATIONS AND GENETICS

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THE material of heredity, according to genetical theory, consists of genes joined together in linear order to form a number of microscopic threads, the chromosomes, which make up the cell nucleus. In a given species of organism there is a fixed number of chromosomes in each cell, usually two of each kind to form the diploid number, and so two of each kind of gene. Typically each gene is distinct from all the others in a set of chromosomes, and each appears to control the formation of a specific enzyme which takes its due part in the system of chemical reactions in the cell. In preparation for ordinary cell division, each gene synthesizes another like itself. The resulting daughter chromosomes separate from the mother chromosomes, from which they are indistinguishable, after each has condensed into a microscopic rod. Each group of chromosomes forms a new daughter nucleus, so that each daughter cell comes to have a chromosome and gene content like the mother cell, and therefore like the fertilized egg from which each cell has arisen by repetition of this orderly process. In the formation of the sex cells, eggs and sperms, there is a specialized type of nuclear division which results in each containing in its nucleus just one set of chromosomes, the haploid number, and so one of each kind of gene.

The rest of the constituents of the cell are essentially by-products, either direct or indirect, of the activities of the genes. There are a few cell constituents known in some organisms which do not appear to be by-products of the genes actually present, although it is possible that they are products of genes that existed in remote ancestors. Like the nuclear genes, these cytoplasmic genes, or plasmagenes, have the property of reproducing to give others like themselves. Both kinds of gene also have the property of occasionally producing a changed gene, a mutation, controlling an altered by-product. The mutated gene, like its ancestor, possesses the property of reproducing itself indefinitely, at least until another mutation happens to occur.

THE PROCESS OF MUTATION

According to the genetical theory of evolution, all living organisms and all their adaptations have arisen through the preferential survival of the rare mutations whose by-products proved to be more favourable for gene maintenance and reproduction, that is for life. In existing organisms, the naturally occurring mutations are predominantly harmful in some way to the organisms in which they occur. Certainly well over 99 per cent. of mutations are deleterious. The very small number of favourable mutations tend to be saved and to multiply and spread through a species. The more numerous harmful ones die out naturally, because of the lower viability or

fertility of the individuals containing them. Thus on the average each harmful mutation accounts sooner or later for one genetic death. Any considerable population of a given species is likely to contain a proportion of harmful mutations at any particular time. The harmfulness is, of course, relative to the state of the common or wild type gene from which a given mutation has arisen. A population, undisturbed by artificial conditions, tends to reach an equilibrium between the number of mutations which arise in each generation and the number eliminated through early death, or non-breeding, of individuals carrying them. What penetrating radiations tend to do is to increase the number of new mutations, so resulting in a greater accumulation of them in the population and eventually a higher rate of genetic death. With radiation continued generation after generation a new equilibrium would tend to be reached at a higher rate of genetic death that matches the higher rate of mutation.

Mutations have been classified arbitrarily by geneticists according to the ways in which they are shown by the individual organisms. In respect of a given gene and a given mutant of it, an individual organism may be hybrid or else pure for either one. The expression in the hybrid generally lies between those of the two pure types, although usually so closely approaching one of them that refined methods of observation are necessary to detect the slight difference. If the hybrid expression is like the normal, the mutant is said to be recessive. If the hybrid is markedly unlike the normal, the mutant is said to be dominant. The distinction, however, is not absolute, and a deleterious recessive may have slightly deleterious effects in the hybrid state. Most mutations are recessive to the normal. A lethal mutation is one which kills every individual before he can reproduce. A visible mutation is one producing an altered, but viable, individual. Individuals showing such visible mutations generally can breed, but they are often, and perhaps almost always, to some extent less viable than the normal. There is also a class of mutations, probably very numerous, that has no obvious visible or lethal effect but merely a slightly detrimental effect on viability, vigour or fertility. In man, for example, hæmophilia is a recessive lethal mutation, sex-linked in inheritance and almost limited in expression to males. Albinism is a recessive visible mutation, fairly obviously to some extent deleterious. Chondrodystrophic dwarfism is a dominant visible, very harmful, since the individuals have a shortened life span and produce only about a fifth as many children as their normal sibs. Dominant lethals of course disappear as soon as they arise; perhaps some monsters are of this kind. No proper estimate has yet been made of the total frequency of such obvious genetic defects in man and of the average reduction in fitness in the population consequent upon it, let alone an estimate of the effects of the probably more common genetic defects having more minor effects on fitness. These are necessary to any judgment of the likely eventual effects of prophylactic measures that enable various grades of genetical defectives to breed, and of the effects likely to ensue upon the chronic or occasional exposure of

individuals or populations to agents, such as radiations, that increase the frequency of mutation.

EFFECTS OF RADIATION ON MUTATION

Exposure to radiation results, in the animals and plants that have been studied, in all kinds of mutations which are similar to those that occur naturally. They are similar especially in that when classified according to their types of effect, the different classes appear in substantially the same proportions among the induced as among the natural mutations. However, the frequency of the induced mutations may be greatly above the natural one. Most of the quantitative data have been gathered for the little fruit fly, *Drosophila melanogaster*.

In drosophila, in the case of a particular class of mutations, the sex-linked lethals, a dose of 5000r produces about 15 per cent. of mutations. The natural mutation rate per generation is about 0.15 per cent. That is, a dose of about 50r, a quite moderate dose which can be applied in a fraction of a minute, will induce a frequency of mutation in the germ cells equal to the natural mutation rate for the whole generation time and added to the latter. The induced mutation is proportional to the total dose over the whole range investigated, down to total doses as small as 25r. There is good reason to conclude that there is no threshhold dose, i.e., no dose so small that it gives no mutational effect. Also, the intensity of the radiation appears to be without effect on the frequency of mutation induced by a given total dose. A dose of 50r given in a fraction of a minute appears to give no greater effect than the same dose given in the course of a few weeks. There is no threshhold, no time factor, and no recovery, the effects being cumulative. Different kinds of radiations differ little in effectiveness from one another. Neutrons differ most, having a lower efficiency, about two-thirds that of X-rays.

There are some accompanying conditions which influence the frequency of mutations induced by a given dose of radiations. Immature germ cells appear to be somewhat less sensitive than spermatozoa. A higher oxygen tension in the tissue favours a higher frequency of induced mutation.

DELAYED ACTION OF MUTATION

Quantitatively similar effects have been found for several plants and animals, including the mouse, and it is reasonable to suppose that the results may be applied to human beings. In the first place, it is important to note that the immediate offspring of an irradiated person are only slightly more likely to show genetic defects than are individuals in the general population. This is because among the new mutations only the rare group of dominants and the sex-linked recessives inherited by sons from their mothers can be manifested at once without being combined with a like mutation. Together these would probably amount to less than 2 per cent. of the new mutations. In addition, there would be the minor detrimental effects of the recessive mutations in the hybrid state. The full effect of a recessive awaits the oc-

currence of an individual who has received it from both egg and sperm. The major part of the detrimental effects would fall on more remote descendants.

The population may be considered as one in which breeding is approximately at random. Under this condition a completely recessive mutated gene, with a frequency of 1 per cent. in the population, would show in the pure state in a proportion 0.01 per cent., the square of the gene frequency. If the recessive were completely detrimental, so that an individual pure for it was inviable or could not breed, a natural mutation rate of 0.01 per cent. would maintain it in the population. A doubling of the mutation rate in the population, say by a dose of radiation, would raise the frequency to 1.01 per cent. and the proportion of individuals that show it to about 0.0102 per cent. in the first generation, i.e., an increase of 2 per cent. In succeeding generations, extending over an average of about fifty, the increased frequency of defect would gradually dwindle and finally disappear. But the cumulative damage would be considerable, although so spread out in time as to be undetectable by our present methods. A continuance of the doubling in successive generations would gradually raise the proportion of individuals showing the defect to 0.02 per cent. and the frequency of the gene to $\sqrt{2}$ per cent., at which point the detrimental effects of the genetic defect would be just double what they are now. The time needed for such a new equilibrium to be reached might be of the order of fifty generations, say two thousand years. In any event, damage done now to the genetic material must inevitably have effects in remote generations, hidden among and adding to the hereditary defects arising naturally. Finally, it should be mentioned that we are constantly exposed to a low dose of natural radiation, from cosmic and other sources, which has been estimated to account for between five and fifty per cent. of the natural mutation in man.

CONCLUSION

The estimation of the detrimental effects of genetic defect current in the population is not easy. It is easier to obtain some estimate by considering the mutations as harmful solely through the small effects they have in the hybrid state, in which they are by far the most common. It is probably conservative to assume that each individual carries on the average one detrimental recessive mutation. If one assumes that the average dominant effect of the mutations is 1 per cent., the lowering of fitness of the whole population due to genetic causes would be 1 per cent. The true figure may well be considerably higher. Exposure of any part of the population to radiation must inevitably increase it, no matter how small the dose. The hereditary consequence of radiation is not the production of new and bizarre types of genetic defect, but rather an increase in the frequency of those that already beset the species. The effect would be to increase the average defect in the population as well as to increase the frequency of gross defects.

ASSESSMENT OF POSSIBLE CASUALTIES AND DAMAGE

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In the last war, the actual casualties from air attack fell far short of those which were expected and had been planned for before the outbreak of hostilities. It will therefore be valuable to examine briefly the factors which accounted for this discrepancy before attempting to assess the casualties that may result in a possible future (atomic) war, so that at least we may avoid making the same mistakes as last time.

Casualties from the German air raids in the 1914-18 war formed the basis of the estimates on which pre-1940 plans were laid; to quote from the official history of the second world war (Titmus, 1950):—

> 'In the background was the experience gained from the eighteen German air raids on London during 1917-18, when a total of about 128 aeroplanes reached the metropolitan area. During the whole war, about 300 tons of bombs were dropped by the Germans on the British Isles. These raids caused 4,820 casualties, including 1,413 killed. The casualty ratio for the whole country thus worked out at sixteen per ton of bombs. For London, with its concentrated population, the ratio was 121, and for the sixteen night raids fifty-two per ton of bombs. On the basis of these figures the Air Staff considered that it would be "fair to assume that, in densely populated areas such as London, there will be fifty casualties per ton of bombs dropped. Of these casualties, one-third will be killed and two-thirds wounded" '.

In the event, of course, casualties fell very far short of the planning figure of 50 per ton. For the country as a whole they were about 2 per ton, and for the County of London 13 per ton. In considering the reasons for the difference between these planning estimates based on world war I and the actuality in world war II, it is perhaps more satisfactory to discuss only the figures for killed per ton, since this eliminates uncertainties about the possible incomplete enumeration of the slightly injured, who are obviously difficult to count fully. The figures then reduce to about 17 killed per ton in London County in world war I, and 4.2 in the same area in world war II. This difference, by a factor of about 4, appears to be due to differences in the distribution of population in world wars I and II, and to the widespread provision of air-raid shelters in world war II.

As regards distribution of population, we find that slum clearance schemes between the wars, and government-sponsored and private evacuation in world war II, reduced the average population densities in the London Boroughs by a factor of about 2. For example, the average density in Southwark was reduced from 167 persons per acre in 1914-18 to 66 in 1939-45; Bethnal Green from 158 to 68; Shoreditch from 151 to 60; and Stepney from

147 to 49. This reduction of population density by a factor of 2 would, of course, account for a reduction by a similar factor in the average casualties per ton.

The effectiveness of air-raid shelters in reducing casualties in the 1939-45 war was studied in considerable detail, and a number of surveys were carried out to determine the casualties among people in different conditions of exposure. From these surveys it was concluded that: (1) a person in a house was about three times as safe as a person in the open; (2) an Anderson, reinforced brick surface or Morrison shelter was about five times as safe as a house. Certain types of shelter (e.g. unreinforced brick surface shelters and certain types of basement shelters, particularly those under large load-bearing-wall buildings) were not nearly so satisfactory, and hence the overall average for all types of shelter was probably somewhat below this figure. Also, of course, not everyone used shelters; surveys at the time of the London blitz suggested that the percentages of people in the open, in houses, and in shelters were about 5, 60 and 35 per cent. On the other hand, there was almost certainly a greater proportion of people in the open in the 1914-18 war. (The Government of the time actually expressed concern at the public coming into the open when warnings sounded.) It seems therefore that differences in the exposure of the population, due mainly to the provision of air-raid shelters, could easily account for the remaining factor of about 2 between the figures for world wars I and II.

ESTIMATED ATOMIC CASUALTIES

General.—It is clear from the foregoing that in any attempt to estimate atomic casualties in a possible future war particular attention must be paid to the two factors, density of population and the effect of air-raid shelters, which led to such large errors in the estimates made before the last war. Estimates such as those made by the British Mission to Japan of 50,000 killed and 50,000 injured in a British city, which do not take these two factors specifically into account, can be of little value for planning purposes.

The factor *density of population* is best taken care of by estimating casualties for a population at a standard density (taken as 1 person per 1000 sq. ft. equals 43.56 persons per acre equals 27,900 per sq. mile) and then multiplying the results by the ratio of actual population density (for a bomb in any particular position and allowing for evacuation, and the like) to standard population density.

The effects of the *exposure of the population* can best be explored by first estimating casualties on the assumption that everyone is (a) in the open, (b) in a house, and (c) in various types of shelter, and then combining the results to show the effects of varying distributions of the population among the different types of exposure.

The six principal ways in which the atomic bomb can cause death or injury to people in a city are:—(1) Flash-burn; (2) blast; (3) debris; (4) gamma radiation; (5) fire; (6) residual radioactivity.

Our clinical knowledge of the types of injury to be expected from these causes comes largely from observations on the casualties from the Japanese explosions, and although there would be some alterations in the effects of an atomic explosion over a British city, these would be quantitative rather than qualitative. Late sequelæ are not discussed. Injury from several causes will be common, and healing will often be prejudiced after the first ten days by radiation effects.

FLASH-BURN

Flash-burn is only likely to be important for people in the open among whom, in clear weather, mild burns on exposed skin may be caused to a distance of about 2½ miles. In British cities, however, two factors are expected to reduce the incidence of flash-burns among people in the open. First, the weather over British cities is seldom clear, and even a moderate amount of haze causes a substantial reduction in this radius. Secondly, the buildings in a British city, particularly towards the centre where the buildings tend to be high and the streets narrow, provide a substantial measure of shielding from heat-flash to people in the streets. In this article we shall direct attention primarily to people in houses and shelters among whom, provided that people in houses keep away from windows or have their windows shielded by black-out curtains or the like, flash-burn should make only a very small contribution to casualties. For an attack on an unwarned population where a large proportion of the people were in the open, the position would be very different and the incidence of flash-burn might approach the conditions in Japan, where burn casualties were numerically the most important group. It has been estimated that only a small proportion of these were caused by fires, and that about 85 per cent. of all casualties treated during the first week were suffering from flash-burns. We have suggested that with proper precautions flash-burns should not cause many casualties in a British city, but in the absence of these precautions, and if people were caught in the open, burns would be common injuries, both from flash and possibly from ignition of the darker clothing worn by our people. The face and hands would be particularly vulnerable. Flash-burns may be superficial, resembling sunburn (first degree) or deeper with blistering (second degree). These burns are reported as being extremely painful. Deep burns with full-thickness skin loss are relatively painless and, like ordinary deep burns, heal only if small. If large, they require skin grafting (Evans, 1950).

Few direct *eye injuries* from radiant energy were reported from Japan. There were some palpebral burns. People who looked directly at the burst suffered temporary blindness lasting from a few hours to two days. Some hæmorrhage and keratitis occurred, probably due to nuclear radiation. Conjunctivitis was common as a result of smoke and dust.

BLAST

Direct blast (as distinct from the debris produced by the blast) is unlikely

to be a serious casualty-producing agency from the atomic bomb. Experience in the 1939-45 war showed that blast pressures of the order of 50 to 100 lb. per square inch were required to produce serious injury. Pressures of this magnitude would only be reached immediately under a bomb burst at the Japanese height of about 2000 ft., and unprotected personnel in this position would certainly be killed by the other effects of the bomb. Observers in Japan noticed few blast injuries to the lungs or other viscera of the sort sometimes caused by high explosive bombs. The incidence of perforated ear drums was low.

DEBRIS

The secondary effects of blast, such as flying debris, glass and the collapse of buildings, are likely to be one of, if not the most serious, casualty-producing agencies from the atomic bomb, resulting in fractures, lacerations and contusions. One widely recorded set of figures from the Ninoshima Hospital, Hiroshima gives distribution as follows: fractures 11 per cent., lacerations 37 per cent., contusions 52 per cent. (LeRoy, 1947). There is nothing remarkable in the report about fractures and contusions; the lacerations from flying glass caused much trouble. Wounds were often multiple and the many small fragments made removal difficult (Pearse and Payne, 1949).

Unfortunately, the Japanese experience cannot be used directly to forecast what might happen in a British city. The type of building construction in Japan was so different from that in this country that it is impossible to apply estimates of debris casualties in Hiroshima and Nagasaki directly to this country. Moreover, it is not at all certain that atomic bombs used against this country would be burst as high in the air as they were in Japan. Although a high-air burst maximizes the damage and the casualties among a population not in shelter, it is a comparatively simple matter to provide protection from death, even immediately underneath such a burst. Our atomic casualty studies are therefore based on a low-air burst rather than on a high-air burst as used against Japan.

The best method of assessing debris casualties appears to be to estimate from the Japanese experience the distances at which British structures, such as shelters and houses, would be damaged to a particular category, allowing for the lower height of burst expected against this country, and then to use British experience of damage by H.E. bombs to relate the casualty rate in a house or shelter to the category of damage sustained by it. This assumes, of course, that the casualties in a house damaged to a particular category, A, B or C,* should be the same whether the damage be caused by atomic or

*These were the categories of house damage used by Ministries of Health and Home Security in the last war and they were defined as:—A damage—completely demolished. B damage—so badly damaged as to be beyond repair and requiring demolition. Cb damage—uninhabitable due to serious damage and needing repairs so extensive that they must be postponed until after the war. Ca damage—uninhabitable but can be repaired under war-time conditions. D damage—inhabitable but requiring repairs to remedy serious inconveniences.

H.E. blast. Generally speaking, there seems no reason to expect that this will not be the case, although it clearly will not apply very close to the bomb, where the destruction will be much more complete than at a corresponding distance from an H.E. bomb.

Let us now consider the detailed application of this method to people in ordinary British dwelling houses. Table 1 summarizes the results of a casualty survey for flying bombs carried out during the war by the Research and Experiments Department of the Ministry of Home Security.

TABLE 1

DAMAGE AND CASUALTIES IN HOUSES CAUSED BY FLYING BOMBS

Grade of damage	Casualty data								
	Number of houses studied	Houses with complete data							
		Number of houses	Total number of casualties			Total number of occupants	Percentage of casualties		
			K	S/I	L/I		K	S/I	L/I
A	206	191	76	63	20	323	23.5	19.1	6.2
B	172	146	7	29	22	257	2.7	11.3	8.5
Cb	299	282	0	30	19	326	0	9.2	5.8
Ca	173	158	0	4	4	182	0	2.2	2.2
D	44	43	0	0	0	45	0	0	0

The very low death rate, even in completely demolished (A damaged) houses is most striking. It appears to have been largely kept to this low figure by the efficient functioning of the rescue service who dug many uninjured and lightly injured survivors out of the wreckage. Detailed figures for

TABLE 2

SECONDARY BLAST AND DEBRIS CASUALTIES AMONG A STANDARD POPULATION ALL IN HOUSES

Zone	Population	House damage category	Total casualties		
			Killed	Seriously injured	Lightly injured
0- 1,500 ft.	7,050	A	7,050	0	0
1,500- 2,500 ft.	12,550		8,650	1,000	250
2,500- 3,900 ft.	28,000	B	11,750	1,960	1,400
3,900- 6,300 ft.	77,000	Cb	0	7,090	4,460
6,300-10,500 ft.	222,000	Ca	0	4,890	4,890
0-10,500 ft.	346,600		27,400	14,900	11,000

the proportion of survivors who required the services of a rescue squad to extricate them from demolished houses are unfortunately not available. However, a detailed survey of Morrison shelter incidents (for which the rescue problem should be similar) showed that 60 per cent. of survivors in

A damaged and 40 per cent. in B damaged houses had to be extricated by rescue squads, the times taken to dig them out varying from twenty minutes to twelve hours. Clearly, rescue on this scale would be difficult after an atomic incident, and therefore to arrive at an upper limit estimate the trapped survivors (taken as 60 per cent. for A damaged and 40 per cent. for B damaged houses) have been added to the killed. On this basis, and from estimates of the radius at which an atomic bomb of the Nagasaki type will cause damage in each of these four categories, we arrive at the estimate given in table 2 for debris casualties among people in houses in an area where the population density is 43 per acre.

Figures can be derived in a similar manner for the occupants of various types of shelters.

GAMMA RADIATION

The possible gamma radiation casualties can be estimated somewhat more accurately than was the case with debris. The basic data are given below in tables 3 and 4 (Atomic Energy Commission, 1950).

TABLE 3

LETHALITY OF GAMMA RADIATION

Dose (rœntgens)	Percentage mortality
100	0
200	5
300	15
400	50
500	85
600	95
700	100

TABLE 4

PROTECTIVE VALUE OF CONCRETE

Distance from explosion of Nagasaki type bomb (ft.)	Thickness of concrete (ins.) for dose of		
	25r	100r	400r
2000	32	30	22
3000	30	21	12
4000	21	16	2
5000	12	2	0
6000	3	0	0

In applying these figures to the occupants of houses and shelters in an actual city, allowance must, of course, be made, not only for the thickness of material in the house or shelter itself, but also for the probable shielding by surrounding buildings. This leads to the results given in table 5 for a population all in houses at the standard density of 43 persons per acre.

Radiation injury may complicate any other type of injury or may affect those otherwise uninjured (see also table 6). The symptoms range from mild to severe to fatal, depending upon the dose and resistance of the individual. The acute radiation syndrome has been described in four phases (Hempelmann, 1950).

Phase I: initial reaction.—Within an hour or two of exposure to a large dose of radiation, the patient suffers nausea, vomits, and is generally prostrated. After some hours, symptoms may disappear and the patient feels less ill. In very severe cases prostration continues and the patient passes straight into phase III. With small doses the initial reaction may be quite slight.

Phase II.—For a few days or several weeks there is a relatively asymptomatic period. The more severe the illness, the shorter this period lasts. Patients do not feel well but are able to force themselves to considerable physical exertion. The most severe cases do not pass through this latent period at all.

TABLE 5*

GAMMA RADIATION CASUALTIES AMONG A STANDARD POPULATION ALL IN HOUSES

Zone	Population	Total Casualties		
		Killed	Seriously injured	Lightly injured
0-1000 ft.	3,140	2,860	220	60
1000-2000 ft.	9,400	3,860	750	1,410
2000-3000 ft.	15,700	1,420	1,260	1,730
3000-4000 ft.	22,000	nil	440	1,100
Total	50,240	8,140	2,670	4,300

TABLE 6*

TOTAL CASUALTIES FROM ONE NAGASAKI TYPE ATOMIC BOMB AMONG A POPULATION OF DENSITY 43 PER ACRE

Types of casualty	Exposure	
	Everyone in a house	Everyone in a reinforced brick surface shelter
Killed outright or trapped in debris ..	30,000	10,400
Delayed radiation deaths	1,100	3,900
Total killed	31,100	14,300
Injured, not affected by radiation ..	27,000	1,800
Injured by radiation	2,500	8,700
Total injured	29,500	10,500

Phase III.—The effects of toxæmia become apparent through increasing apathy, with development of fever and prostration. Weight loss is marked. There is diarrhœa, which may be severe and bloody. Hæmorrhages occur into the skin and from the mucous membranes. Hair may fall out from the head and body about three weeks after exposure. Infection is the great danger in this phase, and infected ulcers in the mouth and elsewhere are common. This period of acute illness may last for weeks or only days. The slightly injured recover quickly. The most severely injured die quickly, and

*The casualty estimates in tables 5 and 6 are based on a rather lower mortality rate than the most recent estimate given in table 3.

those with intermediate doses fight their battle for weeks to eventual recovery or death.

Phase IV.—The convalescent phase. Patients who survive, enter convalescence, which may be prolonged up to six months, during which weakness and fatigue are the outstanding features and in which the other effects pass away.

FIRE

Whether or not there may be substantial fire (as distinct from flash-burn) casualties depends very largely upon whether or not a fire storm, such as those which caused 40,000 casualties at Hamburg and which contributed so much to the damage at Hiroshima, should occur. It seems unlikely that this major question will ever be settled conclusively unless this country actually suffers an atomic attack. The present view is that fire storms would probably not result from atomic bombs over British cities, although, of course, there would certainly be large numbers of extensive fires. It is only a fire storm with its complete encirclement and destruction of a large area which would produce substantial fire casualties. The question of whether or not fire storms would develop in Britain is, however, so important that even though present opinion may incline to discount them, all planning should take into account the possibility of their occurrence. Assuming for the present that no fire storms would occur, fire casualties have been assessed on the basis of the number of individual fires likely to be started by an atomic bomb and on the last war experience of the number of casualties per fire. On this basis they make a relatively small contribution to the total casualties.

TOTAL CASUALTIES

It is now necessary to integrate the various causes of casualties which we have already discussed in order to arrive at an over-all picture. It would clearly be wrong merely to add up the probable killed and injured due to each cause, since this would overlook the fact that many people may be killed or injured by more than one cause. What we have to do is to determine the risk of injury at each distance and in each type of shelter for each of the causes, and then combine these risks. Thus, if in a particular shelter at a particular distance the risk of death from debris were 50 per cent. and the risk of death from gamma radiation 50 per cent., the over-all risk of death would not be 100 per cent. but 75 per cent., i.e., 50 per cent. would be killed by debris and 50 per cent. of the survivors by radiation. Combining the risks in this way we get the final estimates shown in table 6 for total casualties from one atomic bomb among a population of density 43 persons per acre—about the average for the centres of British cities. For purposes of comparison, these estimates are based on the rather theoretical assumption that the entire population is placed in turn in (a) the last war type of reinforced brick surface shelters, and (b) houses. It will be seen that this type

of shelter reduces both the killed and the injured to less than half what they would be if the whole population were in houses.

OTHER RADIATION HAZARDS

This article has been primarily concerned with the effects of an atomic bomb of known type burst over a British city, and the radiation dangers discussed are those to which people are exposed immediately from the explosion of the bomb. Under certain conditions, however, there might be other radiological hazards which can only be touched on briefly. Their importance must not be minimized, but as yet no really full study is available. When an atomic bomb bursts on a clear day most of the fission products and other residual radioactive material is swept up into the cloud which rises from the burst, and is so dispersed and diluted that the hazard is negligible. Under certain atmospheric conditions, however, it might 'fall out' in denser concentration and produce dangerous radioactivity where it fell. A burst close to the ground or water might also produce residual radioactivity in a circumscribed area and constitute a continued risk to survivors or to civil defence workers in that area. These external hazards, if causing injury, would result in radiation sickness as already described. Work on the maximum permissible doses which can be advised for civil defence workers in a contaminated area for a short time is proceeding, but it is probable that whole-body irradiation with a dose of even 50 rœntgens might result in 5 per cent. of those exposed later developing sickness needing bed treatment. It will only be permissible to accept a risk so far above the safe tolerance dose of 0.1 rœntgen per day in grave emergency.

Inhalation or ingestion of even minute quantities of radioactive dust or other material constitutes an internal hazard by allowing emanation of *alpha* and *beta* particles into the tissues unprotected by skin or clothing. Many of these substances are deposited in bone and would result in severe and fatal anæmia or malignant change.

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THE CASUALTY SERVICE

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In planning for the second world war it was thought that owing to the large number of air-raid casualties which were expected the hospitals in the centre of the obvious target areas would only be able to act as casualty collecting centres and that, apart from very urgent conditions such as hæmorrhage, abdominal wounds and the like, all patients would have to be evacuated as soon as possible to base hospitals for their definitive surgical treatment, and orders were in fact issued to this effect. For this reason, and also from the fact that enormous destruction to buildings was expected, the bed complement of all hospitals within the target areas was reduced in the first instance by some forty to fifty per cent., and a portion of the staff and equipment was moved out to peripheral hospitals.

In actual fact, although enemy air attacks were unpleasant, they never produced an inordinate number of casualties or excessive damage to buildings, and it was found possible to vary the instructions concerning operative treatment to casualties in the inner hospitals in London and elsewhere, and also eventually to increase the number of beds available in them. The largest number of casualties admitted into hospitals in London after a single raid was just over two thousand, and all of these received their definitive treatment in the Casualty Receiving Hospitals before transfer to the Base, which took place in a high percentage of the cases within twenty-four hours.

HOSPITAL SERVICE PLANNING

Conditions in a possible third war are, however, likely to be different: intensive conventional bombing of the type inflicted on Hamburg, the free use of V1 and V2 weapons and the atomic bomb may be employed, and for this reason the present plan is to move hospital beds out of the centres of the populous industrial areas likely to be the enemy's targets, to hospitals on the periphery some miles from the centre of these areas. A small number of beds may be left in the central hospitals, which will be called Casualty Transit Centres, and these will be lightly manned, serving in the main for the treatment of acute conditions in the civilian population before actual bombing occurs. To leave expert staff, both medical and nursing, and valuable equipment in a target area where all might be destroyed would be taking an unnecessary risk, and consequently the major part of the staff and equipment will be moved out to the periphery, to hospitals which are to be designated Cushion Hospitals.

These *Cushion Hospitals* are to be sited on main roads leading from the target area and as near as possible to railways, so as to facilitate evacuation

to base hospitals; the necessary services, i.e. gas, electricity, water and sewerage will be laid on beforehand. They will be situated in expanded existing hospital units, and in huts or tents if the other accommodation is inadequate. It is proposed that the beds to be available in these cushion hospitals should be considerably greater in number than those which have been vacated in the central hospitals, but that only a proportion of them should be staffed and equipped at the outbreak of war; equipment for the remainder would be readily available, and the necessary additional staff would be provided by transfers from hospitals in other areas and by the use of mobile teams of all types.

Along with the moving of hospital beds, blood transfusion centres, laboratories and the like will also be transferred to predetermined sites in relatively safe areas.

In these circumstances, the distance between the site of the bombing and the hospitals will be considerably greater than that which obtained in the last war, and an increased number of ambulance vehicles will clearly be needed—such an increase will, of course, present a difficult problem. After a severe bombing attack, producing in all probability a volume of casualties greatly exceeding anything experienced in this country before, rapid clearance of the cushion hospitals will be essential, and for this purpose ambulance trains accommodating 250 to 300 stretcher cases will be provided for the longer journeys, in addition to couch ambulance transport to cover relatively short distances. The experiences of the last war showed that the majority of air-raid casualties can be moved within twenty-four to forty-eight hours from the time of their admission to a primary hospital.

The organization and establishment of *Base Hospitals* will present great difficulties owing to the number of beds required, which will considerably exceed the number now available, and more especially owing to the fact that a large number of the base hospitals in the last war will of necessity have to serve as cushion hospitals in a future war—some interchange of function may, of course, be possible if the necessity arises. In order to economize in both staff and first-class accommodation the base hospitals are to be divided into two categories, 'acute' and 'recovery'. The number of recovery beds will be equal to, or possibly greater than, that of the acute, and it is estimated that the duration of stay in an acute bed will average about fifteen days: the criterion as to whether a patient is fit for transfer to a recovery unit will be whether or not continuous specialist supervision is needed. The recovery bed units will be only lightly staffed, but arrangements will be made for regular visits by specialists: they will, for the most part, be situated in buildings which would not normally be suitable for an acute hospital. Special centres for plastic and thoracic surgery, and neurosurgery, will be established in the base hospitals, either by expansion of existing units or new installations.

Staff.—In spite of the great increase in the number of beds to be made available (in cushion and base hospitals) it is estimated that, assuming free mobility of personnel, it will be possible to provide medical and nursing

staffs from resources available in the country to cover the additional beds, although staffing will be on a war scale and not on a peace-time footing.

All hospitals will remain under the operational control of the Senior Administrative Officer of the Regional Hospital Boards. For operational purposes the constitution of the existing groups administered by hospital management committees may have to be varied: for each group a medical officer, to be called the Group Officer, is to be appointed to act as a local deputy for the Senior Administrative Medical Officer and to control the first-aid units (see below). Under war conditions the teaching hospitals for operational purposes will come under the control of the senior administrative medical officer of the Region in which they are situated, and there is no intention of interfering with the functioning of the boards of governors.

Central direction will be from Whitehall, and in order to maintain a close linkage with Army Commands and Civil Defence Regions, a principal medical officer of the Ministry of Health will be posted at the headquarters of the former and an assistant principal medical officer at the latter: the duties of this latter officer will be concerned largely with long-distance transportation, the movement of patients from one region to another, and the deployment of mobile first-aid units.

Each Army Command conforms accurately to two, or in some cases three, civil defence regions, but the boundaries of regional hospital areas do not in every case correspond to those of the civil defence regions—the difficulties which might arise from this can be overcome by mutual arrangement between the authorities of the regional hospital areas and civil defence regions.

THE RESCUE AND FIRST-AID SERVICES

In the later stages of the 1939-45 war, rescue and first-aid parties were combined, and it is assumed that the same will obtain if a further war takes place: all members of rescue parties being also trained in first aid. There will, however, be one operational difference, as it is expected that the main body of the civil defence services will be stationed on the periphery of the target area and not in scattered units throughout the area. This will allow of rapid concentration of a larger force at the site of bombing and will, more importantly, lessen the risk of a large portion of the service being annihilated at the onset of the attack.

Mobile units.—In addition, the policy for fixed first-aid posts is to be varied: in the 1939-45 war these posts were under the control of the local authorities; they were not, however, fully used, and in consequence were found to be wasteful of personnel and equipment. For these latter reasons during the later stages of the war many fixed posts were closed down and were satisfactorily replaced by mobile units covering a considerable area: these units were based on hospitals which provided a portion of their staff.

For the future, the first-aid service will be an integral part of the hospital service and will consist of first-aid stations based on selected cushion and base hospitals. The first-aid station will comprise a fixed first-aid post at

the parent hospital for screening purposes, three mobile first-aid sections, and a mobile gas cleansing unit. Each mobile section will be able to act independently, or several could be grouped together to form a larger unit. Medical officers and other personnel for the fixed posts will be provided by the parent hospital; the mobile sections will each have one medical officer drawn from a roster of general practitioners in the neighbourhood and eight nursing auxiliaries. In quiet times the personnel of the mobile sections, other than the general practitioner, will work in the parent hospital.

For *transportation*, each section will have two light cars and one van with their drivers and, for communication purposes, a motor cyclist will be attached to each section. Each section will be fully equipped so as to allow of independent action: provision will be made for artificial lighting and a supply of water will be carried. On arrival at the scene of the incident it is hoped that the mobile units will be reinforced by men detailed from the civil defence forces to act as bearers, and the like. The organization, siting and training of these first-aid units will fall to the senior administrative officer of the region: during active operations the deployment of the mobile sections will in part be under the control of the group officer in charge of the hospitals to which they are attached: overriding control will be in the hands of the assistant principal medical officer at civil defence regional headquarters, as he will have full knowledge of the extent of enemy activity over a wide area, and will be able to move first-aid units from one hospital region to another as required.

The *provision of the ambulances* used for moving casualties from the site of the incident to hospital will be the responsibility of the local health authority. For this reason it will be essential for the group officer of a group of hospitals to have a close liaison with the local Medical Officer of Health: he also will have to be in close touch with the local civil defence controllers so that the mobile first-aid units may quickly be deployed when and where they are needed.

Local authority ambulances will also be employed for the transfer of small numbers of cases between neighbouring hospitals: the moving of large numbers of cases by road will be by coach ambulances, which in the main will be under the control of the assistant principal medical officer at civil defence regional headquarters.

Without an adequate supply of *bearers*, both at hospitals and at entraining points, the whole casualty service will break down: the hospitals themselves will not be able to provide more than a small proportion of the requirements, which will be considerable: some thirty bearers will be needed for continuous work in a hospital during active operations and not less than forty are required at entraining points to ensure rapid loading of trains. Volunteer squads were raised in the last war for these purposes and, for a time, worked effectively; in the later stages, however, help had to be obtained from the civil defence forces, and it seems that in any future war a similar collaboration will be the only possible solution of the difficulty.

THE TREATMENT OF RADIATION CASUALTIES

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THE conditions, physical and medical, which prevailed after the explosions of the two atomic bombs at Hiroshima and Nagasaki, have now been reported in a considerable number of official publications and personal reports. Two points have been particularly stressed: (1) the casualties were of the order of tens of thousands in each city; (2) the vast majority of the casualties were attributable to ordinary trauma and burns, either primary flash-burns or secondary flame-burns.

Accepting that in these cities only 15 per cent. of casualties were suffering from the effects of ionizing radiation, it is realized that too much weight must not be given to consideration of this form of injury alone, the nature of which is still ill-understood and the treatment of which is even more undetermined and speculative. On the other hand, if atomic bombs should ever be released again in war, there is no guarantee that the conditions will be comparable with those in the Japanese cities. It is unlikely that atomic bombs of greater TNT equivalent will have a very much greater range of gamma radiation, although bombs of smaller TNT equivalent would, so far as γ-ranges go, be relatively more effective ('Effects of Atomic Weapons', 1950, p. 374). A bombed population protected by surface shelters, largely from trauma and completely from flash-burn, might still be receiving severe doses of gamma radiation, and situations can be envisaged when most of the casualties were suffering only from the effects of this penetrating radiation.

It is pertinent then, to discuss the treatment of the individual suffering purely from injury from ionizing radiation. This is likely to be mainly gamma radiation. The range of the neutron particles from a 'normal' 20 kiloton TNT equivalent atomic bomb is much less ('Effects of Atomic Weapons', 1950, p. 244), about 2000 ft. for a lethal flux, than the >4000 ft. for the corresponding range of gamma rays.

SOURCE OF PRESENT KNOWLEDGE

Knowledge of the syndrome resulting from such exposures is derived from three sources:—(1) The occasional human case in which from negligence or accident a serious dose of radiation has been received. Most of these cases come from the past when the dangers of X-rays and radioactive

materials were not properly appreciated. (2) The holocausts at Hiroshima and Nagasaki when confusion prevented careful observation in the first days. (3) The well-controlled experiments in laboratory animals.

In spite of the difficulties, the best picture probably emerges from the Japanese incidents. Experimental animals do not necessarily react, especially in the early hours and days, to radiation in the same way as the human being.

THE INFLUENCE OF DOSAGE

The reports issued from the United States on the Japanese casualties ('Effects of Atomic Weapons', 1950, p. 339; Liebow, Warren and de Coursey, 1949; Howland and Warren, 1948) agree that the course of the syndrome depends upon the dose received. The cases reported have been roughly divided into three groups:—

(1) Those receiving supralethal doses—600r and above.

(2) Those receiving midlethal doses—about 300-500r.

(3) Those receiving sublethal doses—about 100-300r.

In each group the symptoms and signs are referable to the damage of the radiosensitive tissues and the complications resulting therefrom. Group 1 cases might be expected to die whatever the treatment. Group 3 cases should mostly recover spontaneously with good general management. Group 2 cases are those in which expert treatment is most likely to make the difference between death and recovery.

It is therefore important to be able, in the earliest hours of admission of cases, to group the casualties according to the doses they have received. Personal dosimeters, if carried, should be read at once: failing that, the reading of the area dosimeter (e.g., of the shelter) should have been sent with the patient. If there is no dosimeter reading the site and circumstance of the casualty should have been recorded, so that estimates can be made of the dose received. If on these physical grounds no assessment of the dose can be made, the grading may have to be made on a clinical basis. Table 1 is derived from 'The Effects of Atomic Weapons', 1950.

From a study of this table it can be inferred that those cases which have had early nausea, vomiting and collapse will present the greatest diagnostic problem. They will need to be sorted into the categories:—

(1) Supralethal dose—by the rapid progression of symptoms and signs during the first week.

(2) Midlethal dose—by the apparent symptomatic recovery during the latent interval before the onset of delayed symptoms at about the third week: these cases will have profound changes in the blood count—immediate lymphopenia, and later, marked depression of the levels of all the white cell elements (total leucocyte counts may be expected to fall to 500 to 2000 per c.mm.).

(3) Cases of anxiety—although they may mimic the case of true radiation damage they should not show marked changes in the blood count.

LESIONS REQUIRING TREATMENT

The ionizing radiation has damaged all the tissues, but some much more than others. The tissues most sensitive to damage by radiation are in

TABLE I.

SUMMARY OF CLINICAL SYMPTOMS OF RADIATION SICKNESS

Time after exposure	Lethal dose (600r)	Median lethal dose (400r)	Moderate dose (300-100r)
	Nausea and vomiting after 1-2 hours	Nausea and vomiting after 1-2 hours	
First week	No definite symptoms		
	Diarrhœa Vomiting		
- - - - - -	Inflammation of mouth and throat	No definite symptoms	
Second week	Fever Rapid emaciation Death		No definite symptoms
- - - - - -	(Mortality probably 100 per cent.)	Beginning epilation	
		Loss of appetite and general malaise	
Third week		Fever	Epilation
- - - - - -		Severe inflammation of mouth and throat	Loss of appetite and general malaise Sore throat
Fourth week		Pallor Petechiæ, diarrhœa and nose bleeds	Pallor Petechiæ Diarrhœa
- - - - - -		Rapid emaciation Death (Mortality probably 50 per cent.)	Moderate emaciation (Recovery likely unless complicated by poor previous health or superimposed injuries or infections)

descending order of sensitivity:—(1) Lymphatic tissue; (2) red bone marrow; (3) testicular epithelium; (4) gastro-intestinal mucosa; (5) skin.

The *bone marrow and lymphatic tissue* are responsible for the production of the cells of the circulating blood. With doses of radiation of this order there results temporarily a complete destruction of these tissues, apart from

the primitive mother cells of the reticulum and endothelial cells. The cells of the peripheral blood will therefore disappear in the order of their natural half-lives (fig. 1).

Lymphocytes disappear first; granulocytes, after a temporary initial rise, fall next; then platelets; and finally, the red cells.

Because of the thrombopenia, and probably also other factors such as capillary damage, hæmorrhage is a common complication. The red cells may therefore fall precipitously at any time from this complication. Because of the granulopenia and from a simultaneous damage of the antibody-producing mechanisms, the general and local resistance of the body to invading bacteria is greatly reduced. Infection occurs readily as a complication

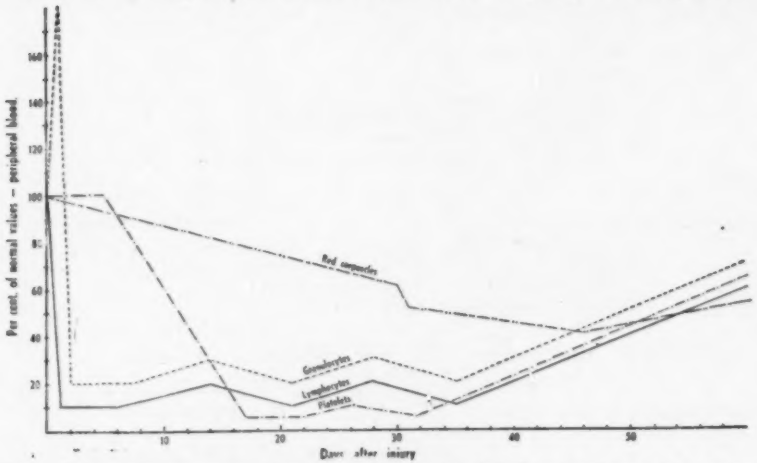

FIG. 1—Diagrammatic representation of changes in the peripheral blood of a patient suffering from injury from ionizing radiation.

of the general syndrome and presents itself generally as bacteriæmia, and locally as necrosis without a normal inflammatory reaction.

Testicular epithelium is very sensitive to radiation but its loss is not, so far as is known, a factor of any importance as regards the outcome in terms of life or death. The primitive cells, contrary to expectation, are relatively resistant to radiation, so that potency returns in due course.

Gastro-intestinal mucosa is also highly sensitive, and lesions here are of definite importance so far as the patient's survival is concerned. First, the damaged mucosa may be a portal of entry into the general circulation of the intestinal bacteria. Secondly, the patient's general nutrition and water balance depend largely upon what his gut can absorb.

The skin.—Radiation burns, as distinct from thermal burns, are not likely to be seen from the hard penetrating gamma rays of the bomb flash. Epilation is, however, to be expected from doses of radiation near the lethal range. It will begin to occur in the second and third weeks. Although clinic-

ally the skin may not show signs of severe damage, its general integrity is impaired, and pressure points, needle puncture wounds, and similar minor insults require special prophylactic attention.

In addition to the lesions that are observable with the naked eye at necropsy, or even subsequently with the microscope, there are certainly more subtle biochemical lesions. There is some evidence in favour of a humoral disturbance—for instance, pituitary adrenocortical stimulation and exhaustion. Also cell enzymes, particularly those containing free —SH groups, are likely to be partially inactivated and proteins may be denatured.

RECOMMENDED THERAPEUTIC MEASURES

First stage.—During the first few days the clinical condition of the patient may be closely similar to that of a patient after extensive radiotherapy with complicating 'radiation sickness'; it might almost be regarded as a state of shock. It differs from traumatic shock or shock from hæmorrhage in that, in experimental animals at any rate (Painter, *et al.*, 1947), there is no diminution in plasma volume. In man, however, vomiting and perhaps diarrhœa may lead to dehydration. Therefore from the earliest days it is highly desirable, not only to institute routine treatment of shock with complete physical and mental rest and conservation of body heat, but so far as possible to keep check on the water balance. Input and output of fluids should be recorded, and if vomiting is severe it may be necessary to supply fluid parenterally. The vomiting, it should be remembered, is not only a sign of the shock-like state and the general reaction of the body, but is also an indicator of local damage to the gut. The forcing of fluids by mouth should thus be deprecated, and 'hot, sweet tea' in large draughts should be given only if there is subjective desire for it. As well as the loss of fluid from vomiting there may be a diuresis. Experimental animals certainly show this, and there is some evidence that this is due to depression of the pituitary antidiuretic hormone. Intravenous 5 per cent. glucose, with added normal saline equivalent in volume to the vomitus, may be indicated to counteract the dehydration. In calculating from the fluid balance chart the total volume of fluids required, account must be taken of the insensible fluid loss from the skin and the loss of water vapour in the expired air—a total of approximately one litre a day. Overloading with sodium chloride should also be avoided. It has been shown (Goldman, 1943) that radiation sickness is associated with a depression of the blood chloride levels (possibly an adrenal exhaustion effect), but unless careful biochemical control of blood chlorides is possible, the dangers of undertreatment with sodium have to be weighed against the chances of œdema from damage to capillaries, which does occur, but which usually, it is true, is not manifested at this early stage.

Specific treatment at this stage, owing to our present general ignorance, is limited. There will be a considerable necrosis of lymphatic and hæmopoietic tissues occurring. There may be a considerable release of histamine-like substances (Ellinger, 1945). In post-radiotherapy radiation sickness,

Ellis (1942) has claimed benefit from the use of histaminase, and Lofstrom and Nurnberger (1946) from the antihistamine drug 'benadryl'. The value of these substances, however, has not won universal approval and it is doubtful. 'Dramamine', it has been claimed (Beeler *et al.*, 1949), relieves the symptoms; its effect is not wholly explicable on its antihistamine activity.

The acute effects of radiation are associated with hypotension. In the absence of a diminished plasma volume, this could be explained by the presence of depressive toxic substances (as above, e.g. histamine) or by a direct effect on the autonomic nervous system. On this assumption pressor drugs have been tried for radiation sickness of radiotherapy, and amphetamine (Jenkinson and Brown, 1944) was reported as useful. Ellinger and his colleagues (1947, 1949), assuming adrenal cortical exhaustion as a cause of hypotension, tried deoxycorticosterone acetate and also report good results. Pyridoxine is another substance the use of which has been recommended for radiation sickness (Shorvon, 1949). The mere fact of there being so many recommended agents suggests that none is specific.

The intermediate stage.—This stage, which seems to be characteristic of the syndrome when the causative dose has not been overwhelming, is one of negative symptoms but positive signs. There is apparent subjective recovery from the immediate effects but the hæmatological signs persist or progress. Lymphopenia, already maximal in the first stage, persists, and granulopenia now becomes maximal. Total leucocytes below 600 per c.mm. are nearly always of fatal prognostic significance, whilst if the count stays above 1,500 per c.mm. the outlook is promising (Le Roy, 1947).

The treatment in this stage is therefore so far as possible prophylactic. Above all, infection must be anticipated and feared. The most expert nursing will be of invaluable assistance to the patient. The care of the skin and the maintenance of a clean mouth will be of paramount importance in avoiding skin damage and agranulocytic angina. Every possible measure should be taken to reduce cross-infection by contaminated dust in bed making, floor cleaning and so on (M.R.C. War Mem. No. 11, 1944).

Antibiotics.—Meanwhile, what can actively be done for the patient? Oral and skin infection will probably be from gram-positive organisms sensitive to penicillin. Prophylactic doses should therefore be given as a routine. Streptomycin as an alternative or in addition is also commended. Ideally, aureomycin would seem to be the antibiotic of choice. It is effective against a wide range of bacteria, including those which might invade from the damaged gut and against which penicillin is inactive, and also it is given by mouth, thus avoiding the skin damage from multiple needle punctures. It has not, however, yet had adequate clinical trials and is in short supply.

The maintenance of the patient's *general nutrition* will be most important. In spite of the damage to the gut there is likely to be a return of appetite. On general principles, a low residue, high calorie, high protein diet rich in vitamins is strongly indicated, comparable, say, with the diet of patients with ulcerative colitis. Remembering that capillary damage is likely soon to

manifest itself as œdema, the fluid balance must still be carefully watched and, if necessary, fluids and salts restricted.

Blood transfusion is the other therapy that springs immediately to mind. As with the antibiotics, the main problem is likely to be one of supply and demand. What will be the most rewarding method of using the available supplies after a large incident? In the earliest days the available blood, plasma and plasma substitutes, such as 'dextran' or gelatin, will probably be best used in the treatment of those numerous cases suffering from traumatic shock, hæmorrhage and burns. Statistics of the 1939-45 war show that more than a half bottle of blood or plasma is needed per casualty. If total casualties in an incident are of the order of thousands or tens of thousands, the difficulty will be in finding sufficient fluid for transfusion of those cases alone which are known to respond well to this therapy.

In the case of the radiation syndrome there is no known indication for blood transfusion at the onset. Even in this second stage of latency the indications are not clear-cut. True there is a more or less complete absence of leucocytes, but whole blood transfusion cannot meet this deficiency. The leucocytes in the transfused blood are so few that a complete exchange transfusion or a transfusion of leucocyte cream would be needed. Moreover, if such exchange transfusions were practicable, the donor blood would have to be freshly drawn. The citrate of the present anticoagulant is known to be so toxic to leucocytes that blood stored even for short periods of time contains few if any viable leucocytes. An entirely new method of blood preservation, which would provide a more natural milieu, might permit storage of granulocytes for a useful period of time. However, the amount of leucocytes available would probably never be enough to meet all demands. Even if adequate amounts of fresh blood were available, the life of the transfused leucocytes would in the recipient be hardly longer than in the normal host, which is thought to be a matter of hours for lymphocytes and a day or so for granulocytes. In fact, transfusion experiments suggest that leucocytes of the donor are immediately eliminated from the recipient's circulation (Weisburger, *et al.*, 1950).

The virtues of blood transfusion as practised at present are chiefly those of the maintenance of adequate levels of red cell counts, and the best use for blood will be in the next stage of the syndrome.

The delayed stage.—The earlier the onset of the delayed signs and symptoms the worse is the prognosis. Deaths at this time seem on morbid anatomical grounds to be due either to uncontrolled sepsis or to hæmorrhage, but more subtle biochemical causes cannot be excluded. One can but attempt to treat the lesions that are patent.

Sepsis, once established, needs to be treated with full doses of antibiotics. Local treatment of necrosis should aim at the maximum surgical cleanliness with the minimal possible disturbance of the patient.

It is at this stage that *transfusions* are likely to be most employed. The failure of the marrow will now be manifesting itself as anæmia. Blood trans-

fusions can supply the necessary replacement of red cells. Hæmorrhage, whatever its cause—thrombopenia or capillary damage, or both—will cause further chronic or acute depletion of the circulating red cells. The transfusions, if of blood preserved according to present techniques, will supply few if any functioning platelets, but fresh blood, as in thrombopenic purpura, may have a positive anti-hæmorrhagic action over a period of some hours. It is unlikely that much fresh blood will be available. The chief reliance will have to be placed on stored blood. If this is preserved by the methods at present in use, it should preferably not be kept longer than twenty-eight days. This relatively short life *in vitro* precludes the amassing of large stocks of preserved blood, and thus if large numbers of casualties are to be adequately treated at any one time, improved methods of preservation, not only of the red cells, but also of platelets and leucocytes, must be found so that cellular elements can be kept in viable form outside the body for long periods.

The plasma may also supply a certain amount of utilizable protein for nutritional or specific purposes. Intravenous feeding may actually be necessary if the intestinal symptoms are severe, but it is particularly at this stage that circulatory overloading and water-logging should be avoided. There may be a case for the infusion of selected plasma fractions. For example, albumin is theoretically desirable, both for its nutritive and osmotic properties. Gamma globulin may be indicated for its general antibacterial content. What can be given will largely depend upon available supplies and upon the frequency of major or minor incidents involving a demand for further transfusion fluids. For the real damage to the capillaries, which is at least in part the cause of the hæmorrhagic syndrome, vitamin P and its analogues have been recommended, but the effect is likely to be more prophylactic than curative (Field and Rekers, 1949). Finally, it must be stressed that experiences in Japan showed that many of these cases took a very long time to recover sufficiently to enable them to be discharged from hospital. Chronic ill-health with anæmia and emaciation was often noted. In some cases hidden sepsis was incriminated, but sepsis or no sepsis the treatment is likely to be prolonged.

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THE TREATMENT OF FLASH-BURNS

By J. P. BULL, M.B., B.Chir.

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The intense heat of the explosion of an atomic bomb causes burning of exposed skin surfaces as do other sources of ultra-violet irradiation, such as a mercury vapour lamp or the sun. The depth of the burn depends upon the distance from the bomb. At Hiroshima, erythematous burns similar to severe sunburn were produced 2½ miles from the explosion, and deeper burns at closer range. The radiations travel in straight lines so that shading by solid obstruction occurs and only one aspect of the body can be affected. The position of limbs at the time of explosion may shade other areas, and clothing also gives some protection. The same intense heat which causes the skin burns may also ignite the clothing so causing secondary burns. Current civilian experience shows that these injuries are often very severe Clothing made of cotton or artificial silks is particularly dangerous, whereas wool is relatively difficult to ignite. Urgent attention is needed to the development of other non-inflammable materials (Colebrook and Colebrook, 1949).

It thus appears that patients suffering from flash-burns are likely to include large numbers with superficial burns of parts of the face, the hands and, in women and children, the legs. Others will have deeper burns of the same areas combined with superficial burns under the partial protection of clothing. Others again will have these burns complicated by those due to their clothes catching fire. The most severe flash-burns may also be associated with fatal radiation or blast effects.

The aims of treatment of flash-burns are the same as those for other burns; the prevention of shock, the prevention of sepsis, and the achievement of early healing with the least possible deformity.

FLUID REPLACEMENT

When the burns are less than 15 per cent. of the surface area, loss of fluid from the circulation can usually be corrected by the body's own physiological defences. Fluids by mouth will be needed and are best given little and often. The full face, half the neck and the dorsa of the hands and wrists total about 7 per cent. of the body surface, so that if no other injuries are present, burns limited to these areas should not require transfusion for shock (fig. 1). Addition of one aspect of both legs from the knee will bring the total to about 13 per cent. which, in a child, would require plasma or its equivalent should the burns be anything more than superficial. An adult with such an area of burning would be a border-line 'shock case'.

Patients with areas of partial or full-thickness skin burns totalling 15 per cent. or more, develop more severe hæmoconcentration, as can be demonstrated by hæmatocrit or hæmoglobin estimations, rising to a maximum at

twelve to eighteen hours after injury. There is thus a margin of time in which to replace the fluid being lost and so prevent the onset of shock. Plasma is probably the most suitable fluid since it corresponds to what has been lost from the circulation. Blood transfusion has its advocates, but for this, grouping and cross-matching are required, and the interpretation of any subsequent hæmatocrit or hæmoglobin reading is confused because of the added red cells. At the end of the shock phase, say twenty-four to forty-eight hours after injury, there is a strong case for blood transfusion of all patients with burns of 25 per cent. or more. The amount and rate of plasma transfusion is a matter of clinical assessment, preferably aided by hæmatocrit readings and urinary output observations. As a rough guide, for an adult, one litre will be required for each 10 per cent. burnt; one half should be given in the first six hours after burning and the remainder during the next eighteen hours (Ross, 1950a; Harkins, 1942; Cope and Moore, 1947). Sufficient, plasma is unlikely to be available for all patients, so substitutes must be sought. A solution of the polysaccharide 'dextran', similar in molecular size to plasma protein, is promising for this purpose. It is used like plasma and restores circulating volume in the same way. It can easily be sterilized and stored, and it disappears slowly from the body without apparently causing ill-effects (Thorsen, 1949; Bull, *et al.*, 1949). All burn patients need to take a high protein diet. This should be started early, in the form of drinks of milk fortified by dried milk, eggs, and the like. If dextran is used in place of plasma the need for protein feeding is even more urgent.

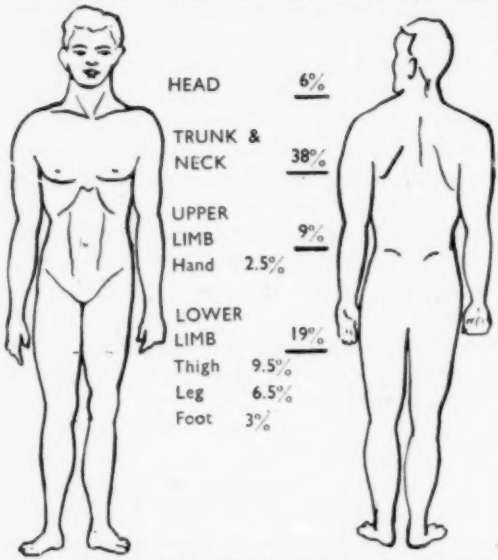

Fig. 1.—Chart for estimating percentage of body area burned.

PREVENTION OF INFECTION

The prevention of sepsis is a matter of care in management, since most burns are free of pathogenic bacteria in their early stages. As compared with other wounds the burn presents a large area capable of picking up air-borne or contact infection. Ideally, all dressings should be performed in

bacteria-free air such as can be provided in a properly ventilated dressing station (Colebrook, 1950). There should be rooms of this type near all large centres so that at least the more severe cases can receive optimal treatment. Failing this, the maximum possible should be done to avoid introducing infection. 'No touch' technique, masks, gowns and caps all help. Local prophylactic chemotherapy is very valuable, e.g. penicillin cream, 500 units/g. Penicillin may also be given by injection. The newer antibiotics, such as aureomycin or terramycin, which can be given orally, may be useful for mass treatment, since systemic penicillin demands more elaborate medical facilities.

CARE OF THE BURNED SURFACE

The course of healing depends upon the depth of burning. The most superficial flash-burns show erythema similar to sunburn and will heal completely with desquamation. During the first day or so there may be spontaneous pain and tenderness. This was described by Japanese observers and is characteristic of the 'erythralgia' studied by Lewis. Such pain can be relieved by cooling (e.g. application of penicillin cream), and by insulation from trauma and thermal changes by use of a closed dressing. More severe burns will blister either immediately or after an interval. With increasing depth there is increasing loss of pain sensation to pin prick, but if this is not completely lost, spontaneous healing from below can be expected in one to three weeks (Bull and Lennard-Jones, 1949). Again, local penicillin cream under gauze, cotton-wool and bandages provides a satisfactory dressing which relieves pain and permits painless removal and inspection for progress.

Full-thickness burns present quite a different surgical problem. Here, satisfactory spontaneous healing cannot be expected. Such areas are completely analgesic to pin prick. The only surviving epithelial elements are at the edges of the burn, and epithelialization from the edges may be indefinitely prolonged, and even if successful gives a bad end-result with scarring and unstable skin. Correct treatment is therefore to graft such areas as early as possible. Some cases are suitable for immediate excision and grafting, and this gives excellent results in expert hands (Cope *et al.*, 1947; Ross, 1950b). A more generally applicable routine at present is to postpone operation until two to three weeks after injury, when the partial thickness areas have shown themselves by spontaneous healing and the slough can readily be stripped from the full-thickness areas. Thiersch grafts are usually appropriate at this stage and can be expected to take well. During the period of healing the general condition of the patient must be maintained; this requires generous feeding to replace protein and tissue loss, and often blood transfusion for severe cases.

EMERGENCY TREATMENT

Having reviewed the aims and general methods of therapy it is well to consider in what way these might need to be modified in the mass treatment of

bomb casualties. The emergency treatment might need to be done by non-medical personnel with only slight supervision. In such circumstances cleansing of the burns would probably do more harm than good, and what is needed is a routine dressing for all cases (Evans, 1950). Present knowledge would suggest penicillin cream or *tulle gras* covered by gauze, absorbent material and bandages; such dressings can remain unchanged for a week or more. Crêpe bandages are preferable, if available, but in an emergency any clean cloth might have to be used. Dressings are difficult to apply to many facial burns and here some compromise with an 'open' treatment will be necessary. Locally, penicillin powder in lactose, as recommended by Kyle and Wallace (1950), may be valuable for areas which cannot be covered. Fortunately, epithelial regeneration is particularly active in facial burns, so that only the deepest usually need grafting. For burns of the hands a special dressing on the lines of that used by the Royal Air Force in the last war may be possible. Such a glove or bag, possibly of a transparent vapour-permeable plastic containing an antibiotic, might be applied over the whole hand, and would both allow minor casualties to continue useful work, and permit subsequent examination and sorting of injuries without removal of dressings.

CONCLUSION

Regardless of what particular supplies are available, the aims of burn treatment should be kept in mind, i.e. prevention of shock in large burns and prevention of infection and furtherance of healing in all. In peace-time conditions good results can be obtained with many patients whose injuries would previously have been thought fatal. Among children and young adults about half the patients with burns of 50 per cent. of the body surface can be saved, and of similar patients with 20 per cent. burns less than one in ten should die. The special circumstances of atomic bomb casualties, their other injuries, and the conditions of treatment, may produce different results, but it is well to realize how good are potential achievements with modern treatment.

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MONITORING INSTRUMENTS AND THEIR USE IN CIVIL DEFENCE

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INSTRUMENTS for the detection or measurement of radioactivity are among the most essential of the tools required in atomic defence. They will be needed to safeguard members of the Armed Forces, Civil Defence workers, and the population generally against taking unnecessary and otherwise unknown risks. In addition, they will be an essential factor in maintaining public morale, since they will provide a means of reassuring a public liable to exaggerate the danger of unfamiliar weapons.

For Civil Defence purposes these tools, known technically as monitoring instruments, will be used in a variety of circumstances. Thus, instruments are designed for measuring the flash dose of radiation occurring almost instantaneously at the time of the explosion of an atomic bomb; others will be used for detecting and measuring radiation from radioactive fission products which have been deposited on the ground, whilst another type is designed for wearing on the clothing and will measure the amount of radiation a person has received when working in a radioactive area. Finally, there is a highly sensitive instrument designed for detecting the presence of radioactive fission products on the body, on the clothing or in food and water supplies.

THE FLASH DOSE

The measurement of this, the most spectacular and the most lethal of the radiation hazards in an atomic explosion is, strangely, the least important in practice. In most situations it is necessary only to consider the effects of the flash dose of gamma rays, since in penetrating power through the atmosphere these rays far outstrip the other forms of radiation. The instruments for measuring the flash dose in an atomic explosion are:—

Fixed dosimeters.—Instruments may be placed in fixed positions, such as on the roof of a building, in the superstructure of a ship or inside a shelter in order to measure the radiation accompanying the explosion. For most Civil Defence purposes, however, the personal type of dosimeter will serve equally well for use as a fixed instrument.

Personal dosimeters.—Special instruments are designed for carrying on the person to record the dose of radiation (e.g., from 50 to 700 rœntgen) likely to cause morbidity or death. The use of these instruments by the Civil Defence and Armed Forces will give valuable warning, so that persons who have received a serious dosage of radiation do not further jeopardize their chances of recovery either by exposing themselves to more radiation or by subjecting themselves to strenuous exercise. Dosimeters for this purpose may be of quite simple structure: thus a

transparent crystal may be used which has the property of turning violet on exposure to radiation. In this case the dose of radiation would be estimated either by reference to a colour chart or, more accurately, by the use of a colorimeter.

MONITORING IN AN AREA CONTAMINATED BY FISSION PRODUCTS

Following an atomic explosion a limited area of ground beneath the explosion will be contaminated by fission products and possibly by small quantities of unexploded plutonium. In addition, the bombardment of the ground by neutrons may cause a certain amount of induced radioactivity in substances on the surface of the ground, and these in turn will emit radiation. The total amount of the residual radioactivity from all these sources will depend upon the type, and particularly the height, of the explosion. Thus in a high-air burst, such as those which occurred in Japan, ground contamination will be relatively slight. In certain circumstances, however, the amount of residual radioactivity may constitute a serious hazard, and it will therefore be necessary for monitoring parties to advance through the area of devastation and to cordon off areas in which it is either unsafe to work or in which persons may only be permitted to work for a defined short period.

In addition to the possible contamination of the ground immediately below the explosion, a phenomenon known as a 'fall-out' may occur. This consists of the deposition of a fine dust composed of a fused mixture of debris sucked up from the ground beneath the explosion, mixed with fission products and falling according to climatic conditions over an area some distance away from the explosion. Most of the radioactive products of the explosion have a short life, and the intensity of the radiation will diminish rapidly after the explosion. With a heavy fall-out, however, there will be problems caused by substances having a longer life and therefore being more dangerous if absorbed by the body. As with the contamination of ground immediately beneath the atomic explosion, the intensity of a fall-out will depend upon the type, and more especially the height, of the explosion, and also on the efficiency with which the radioactive substance in the bomb has been consumed. Should the fall-out be heavy, an important monitoring problem will arise, for its presence must be detected immediately and a decision made whether or not to evacuate the population temporarily from the area. Since the greatest intensity of the radiation is during the first two or three hours, the evacuation, to be successful, would have to be carried out as a matter of great urgency.

Another type of phenomenon, 'the base surge', is one which will be confined mainly to marine warfare, although it can affect land or cities in close proximity to deep water. When an atomic bomb explodes in deep water, in addition to the vertical column which shoots upwards, a bank of mist spreads outwards from the base of the column. This is heavily laden with

fission products and, in addition to being extremely dangerous to any person caught in it, a film of radioactive material is left on everything which has been in contact with it.

In all the three situations described the common element is the presence of fission products giving rise to beta and gamma radiation, and the monitoring problems are therefore similar. The monitoring team and any other persons allowed to enter the contaminated area must wear adequate protective masks and clothing to prevent the ingestion of fission products and to shield the body from beta radiation.

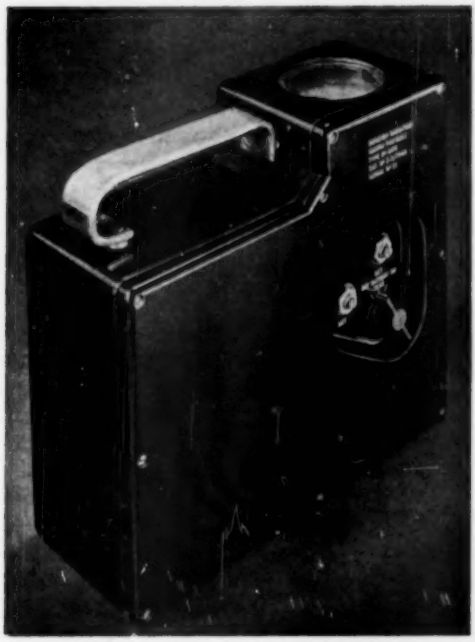

Fig. 1.—Portable dose-rate meter.

The portable dose-rate meter.—This is the instrument which will be carried by all monitoring parties when entering an area of suspected contamination. It is an ionization chamber of sturdy construction, capable of withstanding a drop of 4 feet on concrete, is approximately 3 kg. in weight and 3½ in. x 9 in. x 6½ in. in size. It is battery operated. Normally it will measure gamma rays expressing the measurement in the form of rœntgen per hour, but by uncovering a small window, beta radiation may also be admitted and measured (fig. 1).

The detection and measurement of radioactivity in a contaminated area is the prelude to a decision whether persons may be allowed to enter the area, and if so, a determination of the length of time they may be allowed to stay. The amount of radioactivity will vary considerably in different parts of the area and will be rapidly diminishing during the first hours after the explosion. Readings from the portable dose-rate meter will have given an approximate indication of the maximum period which anyone may be allowed to stay in the area. It will, however, be necessary for at least one of the members of each party working in the area to be provided with an individual dosimeter which will show the total amount of gamma radiation to which his body has been exposed. By taking frequent readings of this instrument it will be possible for the person to tell when he or she has re-

ceived the maximum permissible dose of radiation and must therefore leave the area.

The individual dosimeter.—The dosimeter designed for carrying in the pocket is a quartz fibre electroscope. It is the shape and size of a fountain pen and has an eyepiece at one end. When this is applied to the eye in the manner of a telescope an illuminated scale is visible showing the amount of gamma radiation received by the instrument. The dosimeter must be charged before use and the amount of charge lost is proportionate to the dose of radiation which the individual has received. It does not measure beta radiation (fig. 2).

RADIOACTIVE CONTAMINATION OF CASUALTIES, CLOTHING, FOOD AND WATER

The duties of Civil Defence workers may take them into contaminated areas, and members of the Armed Forces may have to carry out operations in such areas; and members of the public may have been contaminated during a 'fall-out'. The danger of absorbing radioactive products is so great that all food and beverages suspected of having become contaminated in such an area must be monitored carefully before being pronounced fit for consumption. It is apparent that the monitoring instrument used for the detection of radioactive contamination must be of the highest sensitivity, since it must detect the presence of traces of fission products which, if absorbed into the body, might continue emitting rays throughout a person's lifetime.

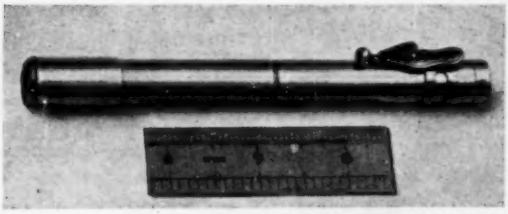

Fig. 2.—Individual dosimeter.

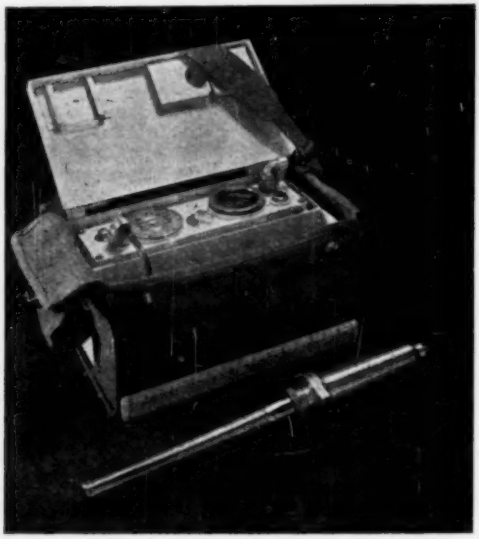

Fig. 3.—Contamination meter.

The contamination meter.—The instrument to be used for the detection of radioactive contamination is a Geiger-Muller counter, and its sensitivity is such that it will measure radiation covering a range from the 'background' produced by cosmic rays up to approximately one

rœntgen per hour. In addition to the counting unit, the reading of which is shown on a dial, there is a loudspeaker to give an audible warning of the presence of contamination. The detecting element is a detachable probe head, different designs of probe being used according to the type of work. One form may thus be fixed to a door-post for the speedy detection of contamination of people passing through the door. Other forms of probe will be used for the monitoring of clothing, food, and for the localization of contamination on the human body. The contamination meter will also be the basis for the instrument to be used for monitoring water supplies. The instrument is robust, will withstand dropping on to a hard surface, weighs approximately 8 lb. and in size is 10½ in. x 4 in. x 7 in. It may be either battery operated or have an attachment for use with an electric power point (fig. 3).

TRAINING IN THE USE OF MONITORING INSTRUMENTS

Monitoring teams must be well trained in the use of their instruments, yet it would be impracticable during training to use doses of radiation approaching the size necessary to operate the portable dose-rate meter or the individual quartz fibre dosimeter. In the case of a contamination meter no problem arises, owing to the high sensitivity of the instrument, and even the small amount of radiation given out by the luminous dial of a watch is readily detected. To provide adequate training in the use of portable dose-rate meters and individual dosimeters, special training models of high sensitivity have been designed, and these will be used in conjunction with specially prepared faint radioactive sources. By this means it will be possible to plan exercises which will simulate as closely as possible the problems with which the monitoring team would be faced following an atomic explosion.

The author is indebted to the Atomic Energy Research Establishment, Harwell, for the illustrations; these are Crown Copyright.

THE TREATMENT OF RADIATION CASUALTIES

References (continued from page 614).

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THE PEPTIC ULCER PROBLEM

By F. H. BENTLEY, O.B.E., M.D., F.R.C.S.

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THE attitude of the practitioner to the problem of peptic ulcer is often one of difficulty and doubt. Before a decision can be made about a patient suffering from gastric or duodenal ulceration, three questions present themselves:—(1) How much can the patient be helped by counsel and advice as to his mode of life? (2) How much benefit can be expected from medical treatment, and what in fact is adequate medical treatment? (3) At what stage of the complaint should surgical treatment be recommended, and how desperate or successful a remedy is it likely to be?

The answer to these questions is not yet plain, and there are several factors responsible for this. First, in spite of the prevalence of peptic ulceration, its natural history is not yet known, making it difficult to assess the patient's subsequent progress. Secondly, there is also the problem of the patient, his emotions, background and responsibilities. It is pleasant to avoid the phrase 'psychosomatic disorder', but in no branch of medicine is it more important to consider and treat the patient himself, and not just his disease. Thirdly, there is the condition of the ulcer. If it is fairly small and shallow with only moderate swelling and deformity, the ulcer is capable of healing and of staying healed, since there is relatively little scarring in the submucosa. If, on the other hand, the ulcer is large and deep, it is surrounded by an extensive block of avascular scar tissue. The ulcer is no longer just a peptic but a chronic ischæmic one, and it is very difficult, perhaps impossible, for this type of defect to heal and remain healed.

A shrewd idea of the condition of the ulcer can be obtained from the patient's history. The shallow ulcer prone to heal affords a history in which the bouts of pain do not last long, perhaps for about two to three weeks, and are interspersed with intermissions of good health, lasting many months. A chronic ischæmic ulcer gives rise to a different clinical pattern: the bouts of pain and ill-health last longer, often for four to six weeks or more, and the history extends over many years, with periods of remission getting shorter and less complete. The pain is not only in the upper abdomen but also in the back, as the ulcer process involves the tissues behind the stomach or duodenum. The typical time relation to food is lost, and ease by food and alkali is less complete. The change in pattern of the clinical picture as a shallow peptic ulcer becomes chronic and ischæmic is usually plain to follow. Within these limitations, imposed by the lack of present knowledge of the natural history of peptic ulcer, the problem of the patient's background, and the condition of the ulcer itself, the practitioner has to decide his attitude to the individual case, and it will be helpful to discuss the three main problems with which he is faced.

CAN THE PATIENT BE HELPED BY COUNSEL?

Can the patient in fact learn to live with his ulcer? It is unlikely, and probably impossible, for any patient to learn to live satisfactorily with a deep chronic ulcer, for the repeated bouts of ill-health, loss of work, dietary restrictions and general unhappiness represent a great burden. But in the presence of the more shallow type of ulcer, much can be achieved if the patient can be persuaded to understand and accept a healthy way of life. If the patient will agree to slow down the tempo of his affairs, to take life more easily and not fume and fret, to eat regular meals and avoid excesses of the body as well as of the emotions, he will set himself on the way to relief from his ulcer tendency. To be more tranquil, regular and orderly is perhaps a counsel of perfection, and in some employments a counsel that can hardly be followed, but in general much can be achieved by these patients in the earlier stages of ulceration once the problem is explained to them and the remedy made plain. If the ulcer is, as yet, a shallow one and the patient intelligent and cooperative, he may indeed learn to live with his ulcer, and in time outgrow it.

MEDICAL TREATMENT

What is medical treatment more than attempting to modify the patient's temperament and behaviour by understanding and advice? This is perhaps the essence of treatment, but there is something more to be added. If the patient is having severe pain and is ill, there is only one place for his treatment, and that is in bed, where rest and freedom of mind and body from responsibility are best obtained, and where the frequent bland feeding which is the basis of medical treatment can be started. The principle is the same whether the predilection is for Dr. Sippy's diet, for milk drips, or for more agreeable and simple measures based on two-hourly feeds with milk, eggs, purées, jellies, and, at a later stage, creamed chicken, fish, soups, and so forth: it is to keep the gastric secretion constantly diluted and neutralized by the natural and best agent—food. Too much can be made of diet, for in its essentials it consists in the simple and commonsense principle of bland nourishing ordinary food, taken regularly at frequent intervals. After two to three weeks of rest, with a gradually increasing diet, the patient is ready to begin a steady convalescence towards normal activity.

An alkali can assist frequent meals in reducing gastric acidity to a safer level during this period of active treatment. With many drugs to choose from, magnesium trisilicate powder is efficient, easy to take, and inexpensive, and in a dose of one teaspoonful taken four-hourly between feeds it is a useful adjunct in treatment.

During the period of remission a most important factor in preventing relapse is the patient's behaviour but, in addition, he needs to be advised not to go more than three to four hours without eating, and to avoid indigestible foods, such as fried dishes, and spiced or irritating articles of diet. It should not be necessary to enforce dietary restrictions which resemble

a penitential fast, and a patient will learn readily enough what to leave alone. A little imagination and skill, even in days of rationing, can extend the horizon beyond the vista of fish, eggs and milk!* Magnesium trisilicate powder, four times a day between meals, or one of the several proprietary tablets of aluminium hydroxide chewed at similar intervals, is also worth persevering with while the patient is well. Equally useful, especially for patients with sedentary occupations, is tincture of belladonna taken by mouth, an hour before meals.

Two other matters need attention: the condition of the teeth and gums, and the habit of smoking. Oral hygiene is obviously essential—and surprisingly often needed; when indicated, it should be seen that satisfactory dentures are worn. The abuse of smoking should be checked, like all abuses, if the patient is anxious to be helped, but there is no evidence that smoking in moderation affects gastric secretion, or harms the ulcer patient; about 10 cigarettes a day is a fair compromise.

Does such a regime succeed, and can many victims of peptic ulceration expect to carry out useful and pleasurable lives, with guidance and treatment from their family doctor? It is my belief, as a surgeon, that the answer to these questions is 'Yes', if the ulcer is shallow, the patient competent to accept advice, and—an important consideration—the practitioner is skilful in understanding and managing his patient.

WHAT ARE THE INDICATIONS FOR SURGICAL TREATMENT?

In considering the value of surgery for peptic ulcer there are four questions which practitioners must be asking themselves at the present time:—(1) What are the indications for surgical treatment? (2) What operation should be done? (3) What is the risk to the patient? (4) What sort of result can be expected?

(1) *The complications of peptic ulceration—perforation, stenosis, bleeding.*—The first, perforation, is an automatic surgical emergency. The next, stenosis, also can only be treated by operation and, in my opinion, affords the sole remaining indication for the short-circuiting operation of gastroenterostomy. If the ulcer is no longer active, and stenosis is the result of scar contraction following healing, gastroenterostomy gives a brilliantly successful cure, for it is a mechanical treatment for the relief of a mechanical condition.

The method of treatment for hæmorrhage from a peptic ulcer is more debatable. The practice varies in different countries, and in different clinics in this country, but there is gradually emerging in many general hospitals an attitude with much to commend it. It is to treat hæmorrhage from a peptic ulcer as a medical emergency in the first place: put the patient to bed, give him adequate doses of morphine, maintain fluid feeding and then observe the pulse rate and any further vomiting or melæna. A slow drip

*Much useful guidance is to be found in *The Practitioner* pamphlet 'Notes for the Patient with Indigestion'.

transfusion may be needed at this stage. If the bleeding stops, then the conservative attitude is justified. If the bleeding has not ended in a few hours, or if bleeding having stopped begins again, a decision is made to operate. In this way patients come to operation still in reasonable condition, when a good result may be expected. The indications for surgery in the presence of a bleeding ulcer are thus simple: the bleeding fails to stop within a few hours under proper medical treatment, or recurs having once ceased,

(2) *According to the site of the ulcer.*—A duodenal ulcer presents a different problem from one on the lesser curve of the stomach, and it is well to consider them separately.

The term *duodenal ulcer* covers juxta-pyloric ulcers, on either side of the pyloric ring, as well as in the first part of the duodenum, for clinically they behave in a similar way. For ulcers in this situation the indication for surgery can be put quite briefly as 'failed medical treatment'; that is to say, the patient has tried to modify his way of living and has had adequate supervision and treatment under the care of his doctor, but still finds life unsatisfactory and at times intolerable. This may be on account of frequent bouts of pain with ill-health and loss of work, repeated bleeding, or even repeated perforations. The two most useful criteria, in a man who is known to have been adequately treated medically, are the amount of work lost and the opinion of the patient about his condition. If he is managing his work and can hold down an adequately paid job with the loss from illness of only a week or two a year, medical treatment is still worth pursuing. If, however, he is losing a lot of work and wages, say six to eight weeks or more a year, the medical regime is hardly justifying itself. Similarly, if the patient still thinks he can manage to carry on fairly well, both in his work and in his private life, he should go on trying to do so; but when he decides that further years like the last few years are really quite intolerable, the surgeon should be prepared to consider operative treatment.

It is a curious observation that patients with advanced duodenal ulcers, particularly deep penetrating ischæmic ulcers giving several years' history of serious complaint, do much better after partial gastrectomy than do patients with shallow ulcers, little scarring and a short history. Whether, as Dumas says, happiness is the comparison of one state with another, so that only those who have known prolonged misery welcome the change to a pain-free state, or whether the persistence of an ulcer into the deep ischæmic condition indicates a different problem in gastric physiology, would be valuable to understand.

Having decided that the patient's ulcer progress justifies operative intervention, it is still necessary to be sure that his mental make-up does not contraindicate surgery. Modern surgery is atraumatic and leaves little disturbance behind it to remind the patient of his experience. Nevertheless, in a nervous, introspective person, prone to suffer and likely to exaggerate, it may be futile to inflict an abdominal wound and leave the patient with a scarred area on which he can focus his attention. The neurotic 'surgical

abdomen', criss-crossed with scars, is happily a thing of the past, but in dealing with patients with peptic ulcer it is of the first importance to scrutinize and assess them carefully as to their mental fitness for operation, and to advise against it if it is thought that they lack the emotional stability to overcome the temporary disabilities of an abdominal operation.

The indications for surgical treatment of a *gastric ulcer*, however, are rather different. There is no doubt that some gastric ulcers, originally benign, become malignant; there is argument only about the proportion of stomach ulcers which undergo this malignant change. There is also no doubt that some cancers of the lesser curve appear at their onset as innocent ulcers, as judged by clinical and radiological evidence, but shortly prove their malignant nature. Because of these two dangers there is an increasing tendency to advise gastrectomy for ulcers of the lesser curve which do not readily heal and stay healed after one period of adequate medical treatment: also gastrectomy performed for a gastric ulcer can be less destructive than resection done for a duodenal ulcer, and the functional results are excellent.

CHOICE OF SURGICAL PROCEDURE

For a perforated peptic ulcer it is quite sufficient to close the hole in the bowel wall, and leave the question of more radical surgery, should indications persist, in the future. It is not known what proportion of patients have further ulcer symptoms after perforation of a peptic ulcer, but certainly many remain well and relatively symptom-free for some years after this dramatic episode. When, however, operation has to be performed for a bleeding ulcer, partial gastrectomy should be done, if technically possible. If it appears to be too dangerous or difficult, then the bleeding must be stopped by ligature of the bleeding vessel, opening the stomach or duodenum for this purpose, although this is a much less certain and satisfactory procedure.

Not only for hæmatemesis, but in all cases of chronic peptic ulceration, *partial gastrectomy* is the operation of choice, and can be recommended confidently, for the operation has been developed over a considerable period of time, and the results critically observed. It is agreed, with few dissentients, that gastroenterostomy should not be done for an ulcer in the active state because of the risk of a new ulcer forming at the anastomosis, even if the original ulcer heals. Gastrectomy has a threefold aim: to remove the ulcer-bearing area of stomach and duodenum, to reduce the secretory power of the stomach, and to cause the portion of stomach remaining to empty more rapidly so that the acid secretion is not long retained. A partial gastrectomy properly performed readily achieves these aims.

For twenty-five years partial gastrectomy has been the accepted treatment in some surgical clinics, and during this quarter century a large volume of evidence has accumulated. Only in such a long period can an adequate opinion be given about any procedure which claims to modify or cure peptic ulceration. For that reason alone it would be necessary to speak about *vagotomy* as a curative operation with caution and reserve. Experience is

being gained, and there is no doubt that many patients are well after the vagal supply to the stomach is cut; but some are not, and there has not been sufficient time or enough material collected for a proper assessment to be made. Vagotomy has the advantage of being a relatively simple procedure, and should have a lower mortality than the more extensive operation of partial gastrectomy. On the other hand, it may have unpleasant side-effects. It would not be profitable to enter the controversy for and against vagotomy, for the facts on which alone a decision can be made are not yet available, and it is hoped that those who advise this operation will obtain the evidence in a critical and adequate way.

WHAT IS THE RISK TO THE PATIENT OF PARTIAL GASTRECTOMY?

When performed for continuing hæmorrhage, the risk depends upon the stage of bleeding at which the operation is performed. In clinics where the policy is adopted of operating only in the last resort, mortality figures for operation are necessarily high. Where hæmatemeses are operated on early in their course, there are proportionally few deaths. The position is made the more difficult to assess because the risk is much greater in patients over fifty to sixty years of age, and the statistics of a clinic are bound to vary according to the number of older patients treated. In a large number of patients, with a considerable admixture of older people, treated surgically as soon as it is clear that medical treatment is not succeeding, it is likely that the mortality of operation will be about 5 to 8 per cent., a figure reported by some workers in this field and one that represents a considerable achievement.

In the non-urgent gastrectomy, the risk to the patient might be thought to depend on the one hand upon the condition of the patient and on the other on the surgeon and his organization. But in point of fact, the risk does not greatly depend upon the state of the patient, for with adequate preparation for operation, skilful anæsthesia, accurate and gentle surgery, and knowledgeable postoperative management, it should be possible to operate safely even on the ill patients who make up so large a part of the practice of a gastric surgeon. The risk is not so much in the condition of the patient, for that can be made adequate: it lies in the balance between the inherent difficulties of the operative procedure and the skill with which they are met. In skilled hands and in a proper organization the mortality is therefore small: about 2 per cent. in many gastric clinics. The mortality in hospitals all over the country is higher, and it is one of the challenges to surgery that the general standard of gastric surgery shall more nearly approximate to the level obtaining in centres where much care, experience and organization are given to the problem. In recommending gastrectomy this operation is not advocated as part of the sausage-machine of a long operation list, an incident in the day, or as a subject for the occasional gastric surgeon; but as part of a carefully planned procedure in a clinic organized for this difficult form of surgery. Without such provision, the risk of operation is not likely to justify the procedure.

Two days after operation the patient is got out of bed, and ten to twelve days later leaves hospital to convalesce suitably for two to three weeks. About two months after operation the question of work is discussed with the patient, and he is encouraged to begin light work, going on to full strenuous activity as soon as he feels fit enough, usually in another month or so. From the time of leaving hospital he is advised to eat what he fancies, avoiding only indigestible things, and to take small meals at regular intervals until the stomach and jejunum are accustomed to the new state of affairs. He is further questioned and counselled about his activity and mode of life at three-monthly intervals; until after a year he needs no further supervision.

In order that the result shall be considered satisfactory, a patient after partial gastrectomy needs to be able to eat what he likes, to feel normally well and healthy and to be able to follow the occupation of his choice. These are high standards, but with proper selection of cases, about 90 per cent. of patients obtain a satisfactory result following partial gastrectomy, observed over five to twenty years, and become grateful healthy beings.

It has been said that although excision of part of the stomach removes the ulcer and its symptoms, it leaves the patient less strong than before and not able to do heavy work. This does not agree with my experience so far, for there are ex-patients from this Clinic hewing coal, filling coal tubs, operating hydro-blast jets and stoking furnaces, with full satisfaction to themselves and to their employers, and these are truly heavy jobs! It is necessary, of course, first to select the case for operation by correct criteria, and then, after operation, to continue from sympathy through encouragement to stimulation, guiding and grading the man's activities up to the full level of exertion needed.

The results are indeed satisfactory, for they comprise those patients whom medical treatment failed to alleviate, and who would otherwise be of little use to themselves or their families. A comparison of medical and surgical treatment of peptic ulcer is not, however, intended, and is in fact futile. It is not a question of comparing medical and surgical results, but of deciding which patients can adequately be controlled by medical treatment, and at what stage surgical treatment should be undertaken. The attitude of the surgeon who would remove the stomach of any patient with a duodenal deformity would seem as stupid as that of the physician who continues with alkalis and diet for a patient who may have been six times in hospital, lost months of work, and has an ulcer deep into the pancreas! Peptic ulcer is an excellent example of a disease process which should be treated by a group of physicians, some of whom are skilled in operating.

It is a pleasure to acknowledge the help of Mr. T. G. Cameron, F.R.C.S., who is responsible for the follow-up in this Clinic; and also the critical advice of Dr. J. Gray Newton, who knows so well the practitioner angle on this problem.

DIAPHRAGMATIC PAIN IN CHILDREN

By RONALD MacKEITH, D.M.
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THE following case history was recently submitted to me by the Editors for an opinion as to the diagnosis.

CASE HISTORY

A girl, now aged ten years, at the age of two months was heard one night to be in respiratory distress. She was found to be slightly cyanosed, with increased respirations, almost of the type found in pneumonia. She was given a pinch of sodium bicarbonate, after which she brought up some wind and the attack passed. Four months later, at about eleven one night, the child had a similar attack but seemed to be much worse. She was rushed to hospital for oxygen treatment, but by the time she reached hospital, forty-five minutes later, she was all right again. The child had a few similar attacks until the age of four-and-a-half years, i.e., in 1944. She was too small to explain, but always seemed to be in pain, as she gave distressing cries. The attacks never seemed to last for longer than an hour. In 1943, she was X-rayed, and the radiologist reported that there was no evidence of diaphragmatic hernia, and that the chest was clear. In December 1944, she had another attack, and then cried, saying: 'It is sore. I can't breathe', pointing to the side of the chest. For that particular attack relief could only be obtained by administration of 1/10 grain (6.5 mg.) of morphine.

From December 1944 to October 1949, she was quite free of attacks, and then suddenly felt the pain again. It started in the left hypochondrium, or the lowest ribs, and on the left side of the neck. Clinically, the pain is absolutely like a diaphragmatic pleurisy, but it is only occasionally accompanied by a slight temperature and passes off fairly suddenly. In December 1949, the child was again X-rayed for diaphragmatic hernia, and the film was again negative. In spite of this I still thought it was a case of diaphragmatic hernia, but in January of this year she had a bad attack, this time all on the right side. Again, pain on the side of the chest and in the neck. There are no physical signs during an attack, and two X-rays taken during an attack show nothing abnormal; the diaphragm moves freely. The last attack occurred four days ago, again left-sided and referred to the neck. It started suddenly on a Sunday at 1 p.m.; pethidine, 50 mg., was given at 1 p.m. and again at 4 p.m. Next morning the pain was easier, but in the afternoon it suddenly became very severe, the child crying for an injection to relieve her. It passed off completely on Wednesday. The child's health is otherwise excellent: there is no fatigue or dyspnœa, and no previous illnesses of note. She keeps quite well until the attack comes like a bolt from the blue.

Significant features:

(1) The attacks come on very suddenly and pass off fairly quickly.

(2) The pain has definitely been left- as well as right-sided.

(3) The pain must be of diaphragmatic origin because the child always has this pain referred to the neck.

(4) There have never been any bowel symptoms or signs of obstruction.

(5) X-ray during the attack shows nothing abnormal. No pneumothorax.

(6) My own opinion is that the condition may be caused by diaphragmatic spasm, if such an entity exists.

(7) There is no family history of allergy.

COMMENTARY

The clinical problem here is not easily solved and is therefore best ap-

proached in a somewhat formal way. In summary, this otherwise healthy girl from the age of two months to four-and-a-half years has had half a dozen attacks of respiratory distress lasting for not more than an hour. In one she complained 'it's sore: I can't breathe', and needed morphine for relief. After being free from attacks between the ages of four-and-a-half and nine-and-a-half years she has had three attacks in the last six months. In the first of these there was pain of sudden onset and termination in the left hypochondrium and over the left lower ribs and on the left side of the neck. The second was similar but with pain on the right side of the chest and neck. The third attack lasted several days and was accompanied by slight pyrexia. No abnormal physical signs have been observed, and X-rays during an attack are reported as showing no hernia, no abnormalities, and a freely moving diaphragm.

As the inquirer points out, the picture is that of diaphragmatic pain (Capps, 1932). Diaphragmatic hernia is almost ruled out as the pain has been on both aides. A recurrent acute inflammation of the diaphragm or of its pleura would explain the symptoms. Bornholm's disease (Hopkins, 1950) produces this 'devil's grip' picture but it does not recur thrice in six months. Acute primary diaphragmitis is described (Joannides, 1935) and is sometimes called Hedblom's syndrome. This inflammation of the tissues of the diaphragm may be accompanied by pleurisy, but such frequent attacks are not typical, nor are the brief ones seen in this patient's earlier phase. Parasitic inflammation from trichinelliasis of the diaphragmatic muscle is not uncommon in this country if looked for at necropsy—10 per cent. of 472 necropsies—but these are subclinical infections without symptoms. Hepatitis must be mentioned only to be dismissed as a cause for the type of attacks under consideration here. It may be necessary to conclude that the child has a recurrent pleurisy of the pleura over the diaphragm, but this is not quite satisfactory as a final conclusion.

The patient has been under close medical examination, and therefore attacks of paroxysmal tachycardia or of paroxysmal hypertension (adrenal sympathetic syndrome) need not be further considered. Flutter of the diaphragm (Goodman, 1941; Söderstrom, 1950) is not painful. It is revealed by the fluttering movement of the epigastrium and by auscultation (a to-and-fro noise is heard over the lower sternum) or by screening.

DIAGNOSIS

A recurrent 'cramp' of the diaphragm is suggested as a diagnosis. In itself such a diagnosis does not, of course, explain why the muscle should go into a tonic contracture. Screening during an attack should show whether there is a tonic contraction of part or all of one or both cupolas of the diaphragm. The American pædiatrician Abt (1933) refers to this condition, although in tantalizing brevity, in an article on disorders of the diaphragm in infancy and childhood. The relevant paragraph deserves quotation here:—

'Spasms of the diaphragm may be tonic or clonic . . . The tonic spasms are of less frequent occurrence (than the clonic spasms causing hiccough). In these cases the epigastrium is protruded, the diaphragm is stationary, the respiratory excursions are diminished. The patient suffers from dyspnœa and pain at the sites where the diaphragm is inserted. Spasm may occur in tetany and has also been described by Lederer as occurring in bronchotetany. It has been observed in tic and chorea. In epileptic convulsions the diaphragm may show rapid convulsive contractions.

The pædiatrician's neurological bible (Ford, 1945) makes no mention of this symptom complex. An electroencephalogram might yield evidence pointing to an epilepsy affecting the phrenic nerves.

The most important further investigations during attacks are for any evidence of infection, and screening for movement and perhaps spasm of the diaphragm, and for the less likely possibilities, such as recurrent small hernias or pneumothorax.

Treatment, in the absence of a more definite diagnosis, must be symptomatic on the lines already followed. Should the attacks recur, phenobarbitone, ½ grain (32 mg.) twice daily, should be tried for a period of months. An attack which persists should receive treatment with one of the newer antibiotics as being effective against many bacteria and some viruses.

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JACK OF ALL TRADES

THE LIFE OF 'SIR' JOHN HILL, M.D.

By BRIAN HILL

'For physic and farces his equal there scarce is;
His farces are physic, his physic a farce is'.

In this witty epigram the famous actor, David Garrick, summed up the character of his contemporary, Dr. John Hill. A single couplet, however, is too short by far to describe the activities of this remarkable eighteenth-century individual who began life as a humble apothecary and ended it as superintendent of the Royal Gardens at Kew. In between, 'everything by starts, and nothing long', he had been an actor, unsuccessful playwright, botanist, pamphleteer, booksellers' hack, journalist and quack doctor.

EARLY DAYS

Hill was the son of a clergyman and was born, probably at Peterborough, about 1716. If fairy godmothers attended the child's christening, they certainly endowed him with some good qualities. He was blessed with a capacity for hard work, versatility and the curiosity that betokens the scientific turn of mind. All these gifts were nullified, however, by Hill's faults of character. He had little sense of decorum, his vanity knew no bounds and, brave in attack on paper, he proved a coward when his victims turned on him. As a result, he was perhaps the most notorious and the most despised figure of his period.

As the boy had an aptitude for science, he was apprenticed to an apothecary and, on completing his articles, set up in business in St. Martin's Lane, London. He was too ambitious, however, to be content to serve behind the counter

for the rest of his life and soon looked about for speedier ways of making his fortune. He was an enthusiastic student of botany and managed to attract two or three influential patrons—the Duke of Richmond was one—who employed him on the planning of their gardens and the arrangement of their botanical specimens. They also supported him in an ambitious scheme he had for classifying the collections of rare plants and botanical specimens up and down the country. This gave Hill an opportunity—or so his enemies alleged—of adding to his own collection by pilfering specimens from the gardens he visited. One of his detractors, Woodward the actor, quoted 'Romeo and Juliet' aptly against him:'I do remember an apothecary . . . culling of simples'.

THE ACTOR

Wealth and fame still passed John Hill by, so he turned his attention to the stage, confident that he would soon rival even Garrick's popularity with the public. His first appearance was in a small part in 'Othello' at the Haymarket Theatre, but his stage career was brief. It was cruelly summed up by a contemporary:—

> 'Mr. Cross, the prompter, took great pains to fit him for the part of Oroonoko—he was damned. He attempted Captain Blandford—he was damned. He acted Constant in "The Provoked Wife"—he was damned. He represented the Botanist in "Romeo and Juliet" at the Little Theatre in the Hay-market—he was damned. He appeared in the character of Lothario at the celebrated theatre in May-Fair—he was damned there too'.

The public, indeed, seems to have echoed Lady Macbeth's cry, 'Out, damned spot!'

RETURN TO SCIENCE

After this series of disappointments Hill returned to his first love, science. But he had neither the financial resources nor the steadiness of character that would have helped him to bridge the interval that must be got over before he could qualify as a doctor and build up a practice. A candidate for the medical profession in the eighteenth century, as a contemporary writer pointed out, 'exercising the patience of a setting-dog for half a score years in the expectation of death, resignations or other accidents that occasion vacancies, at the end thereof either found himself a hospital physician . . . or doomed to struggle with difficulties for the remainder of his life'.

Hill wanted fame and fortune without having to wait for them, and was only too ready to turn his hand to anything that seemed likely to produce them. A treatise on gems translated from the Greek caught the attention of the booksellers. They noted him down as a useful hackwriter and commissions began to come his way in increasing numbers. Hill took on every job that was offered to him. His capacity for work was astonishing. During

the twenty-eight years from 1746 to 1774, in addition to a vast output of ephemeral writings, he produced the following works:—'A History of the Materia Medica'; 'Essays in Natural History and Philosophy'; 'A General History of Nature'; 'Supplement to Chambers's Dictionary'; 'The British Herbal'; 'Eden, or a Complete Body of Gardening'; 'On the Sleep of Plants'; 'On the Nerves'; 'The Family Practice of Physic'; 'Outlines of a System of Vegetable Generation'; 'On the Origin and Production of Proliferous Flowers'; 'Exotic Botany'; 'Flora Britannica'; 'The Vegetable System' (in twenty-six volumes); 'Hortus Kewensis'; 'Herbarium Britannicum'; 'On the Construction of Timber'; 'On the Origin and Nature of Spar'; 'On a New Mineral Acid'; 'Horti Malabarici'.

Works of this sort might well have given their author a reputation in scientific circles, and indeed at one time they recommended Hill to the attention of Martin Folkes, the President of the Royal Society, and to other influential members of that august and powerful institution. Everything seemed in favour of Hill's election to the Society, but his love of self-advertisement and almost pathological vanity ruined his chances. To compensate for his lack of academic training, he had induced the University of St. Andrews to confer a diploma of medicine on him. It is true that Sir John Hawkins, Dr. Johnson's biographer and one of Hill's many enemies, decried this distinction by saying that the newly fledged doctor had 'obtained through one of those universities, which would scarce refuse a degree to an apothecary's horse, a diploma for that of doctor of physic'; but Hill felt that at last he had established himself. His success went to his head. He began to set himself up as a man of fashion and an arbiter of taste. At Ranelagh and Vauxhall, at the theatre, at every fashionable rout, the doctor's plump figure, dressed to kill, was to be seen pushing itself forward to attract attention. Nor was he content to build up a solid reputation as a man of science, but preferred to turn his hand to pamphlets, satires, novels—anything, in short, that brought his name before the public.

At this blatant self-advertisement the Royal Society shied like a frightened horse. No one could be found to support Hill's candidature, and the President had no alternative but to advise him in his own interests to withdraw for the time being. Hill, however, slammed the closing door in his own face by attacking the Society in print. In 1751 he parodied the style of its Transactions in a critical pamphlet entitled 'A Review of the Works of the Royal Society'. Worse still, he made personal attacks on the President and his former supporters, boasting that it was an 'honour' not to belong to the Society until such time as it could reform itself.

THE JOURNALIST

A scientific career closed to him, or so it seemed, Hill undeterred, embarked on popular journalism. For two years he wrote a daily chatty miscellany, called 'The Inspector', which was published as part of the *Daily Advertiser*.

With his 'lively manner of saying nothing through an entire paper . . . the self-applauding chit-chat and the pleasant repartee', he may almost be said to be the originator of the gossip column. But there was no law of libel to restrain his malice, and he attacked all and sundry. In a short time he was the most hated man in London. Fielding, the famous author of 'Tom Jones', referred to him contemptuously as 'a dunghill'; and an enraged Irishman, meeting Hill at Ranelagh, set about him with his cane and gave him a sound drubbing. As for the epigrams on the Doctor, they were innumerable. One runs:—

'Thou essence of dock, valerian and sage,
'At once the disgrace and the pest of this age,
'The worst we can wish thee, for all thy damn'd crimes,
'Is to take thy own physic and read thy own rhymes'.

This was soon capped by another, which hinted that the Doctor poisoned his patients:—

'Their wish must be in form revers'd
'To suit the doctor's crimes;
'For if he takes his physic first,
'He'll never read his rhymes'.

But these were mere pin-pricks in comparison with a blow from the well-known poet, Christopher Smart. Hill's quarrel with Smart had a curious beginning and shows the lengths to which the 'Doctor' would go to gratify his malice. First of all, he praised Smart's work in 'The Inspector'; then, in another mushroom journal also produced by him and rightly called 'The Impertinent', he made an anonymous attack on the poet. To put people even more off the scent, the next issue of 'The Inspector' gravely reproved 'The Impertinent' for its bad taste!

Hill's disguise was soon penetrated, however, and the infuriated Smart retaliated by publishing what is probably the most savage satire in the English language. Called 'The Hilliad', it recounts the adventures of one 'Hillario':—

'A paltry play'r that in no part succeeds'.
'A hackney writer, whom no mortal reads'.

The Doctor was nicely caught in his own trap and 'The Hilliad' did so much damage to his reputation that he was obliged, at the booksellers' requests, to publish his own works under pseudonyms. Nevertheless, he is said to have earned as much as fifteen hundred pounds in some years by his pen, a very large sum for those days.

THE HERBALIST

Then there were his quack herbal remedies. In his gardens at Bayswater, where Lancaster Gate now lies, he grew the plants from which he manufactured his concoctions. The gullible public soon fell for the advertisements

of Dr. Hill's 'Essence of Waterdock', 'Tincture of Valerian', and other panaceas, although the 'Doctor's' reputation with his fellow physicians fell to an even lower level.

Hill published a stream of pamphlets bringing his herbal nostrums to the notice of the public. In one of them, 'The Virtues of British Herbs', he said:—

> 'It will be happy if, by the same means, the knowledge of plants also becomes more general . . . He who seeks the herb for its cure, will find it half effected by the walk; and when he is acquainted with the useful kinds, he may be more people's, besides his own, physician'.

There is a modicum of good sense in these observations, but, as usual, Hill overdid things, and his enthusiastic pushing of his remedies soon overstepped the boundaries of medical etiquette into the less respectable by-ways of quackery.

CLOSING DAYS

After all this notoriety it is surprising to find Hill at the end of his life surrounded by an aura of respectability. He married the sister of a peer (his first wife was of humbler upbringing, for she had been the daughter of a nobleman's steward); he received an honour from the King of Sweden in return for a presentation set of his botanical works (and immediately styled himself 'Sir John', although he was not entitled to do so); and, through the patronage of George III's all-powerful minister, the Earl of Bute, he was appointed superintendent of the royal gardens. The Earl encouraged Hill, toō, tō produce his *magnum opus*, 'The Vegetable System'. This was in twenty-six volumes, illustrated by 1,600 engravings on copper, and threatened to ruin its author. Lord Bute, however, assured him that he would be properly recompensed for the work and tempted the Doctor to embark on a twenty-seventh volume. It was too much. Worn out by anxiety, work and gout, Hill succumbed in November, 1775.

Whether or not he tried to cure his fatal disease by taking his own physic is not recorded. There is a story that, meeting a fellow-sufferer, he warmly recommended his 'Elixir of Bardana': ' 'Tis a certain cure for the gout', he told his friend. A few weeks later the two men met again. This time the Doctor was limping on two sticks and hardly able to walk. 'Gout?' exclaimed the other, 'My poor fellow! But why don't you try "Elixir of Bardana"? I am told it is a certain cure'.

CURRENT THERAPEUTICS

XXXVI.—MODERN PENICILLIN THERAPY

By SIR ALEXANDER FLEMING, M.D., F.R.C.P., F.R.C.S., F.R.S.

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PENICILLIN was the first highly successful antibiotic to be introduced into medical practice. It was the first antibiotic to be manufactured on a large scale, and the mass production of this substance furnished a great variety of new problems to the chemists and the chemical engineers. All this happened in the midst of a world war and most of the material produced was earmarked for the fighting Forces.

In the Forces there was a rigid control on distribution and dosage, and for a time there was so little available for civilians that here also there was a strict control. In those days the dosage was arranged to get the maximum benefit from the minimum effective dose. Penicillin when injected as a solution of the sodium salt—the usual product—was rapidly absorbed and rapidly excreted by the kidney. The result of this was that to keep up a sufficient concentration in the blood, doses had to be repeated frequently. It was then that the more or less standard dosage of 15,000 units, every three hours day and night, was instituted. This dosage was effective in most cases and in some quarters persists until the present day. Although those three-hourly doses day and night were effective, they were very troublesome to the doctor, the nurse, and especially to the patient, and this treatment was quite impracticable unless the patient was hospitalized. As the supplies increased, dosage was modified mainly in the direction of a general increase, and in many cases doses of 50,000, 100,000 units, or even more, were given at three- or four-hourly intervals. The case for larger doses in special cases was strengthened by Christie's report of the findings of the M.R.C. Committee on bacterial endocarditis. These showed that large doses over a long period gave the best results.

DOSAGE SCHEME AND BLOOD LEVELS

In considering the dosage scheme it is well to know the penicillin content of the blood after different sized doses. This is shown in table 1.

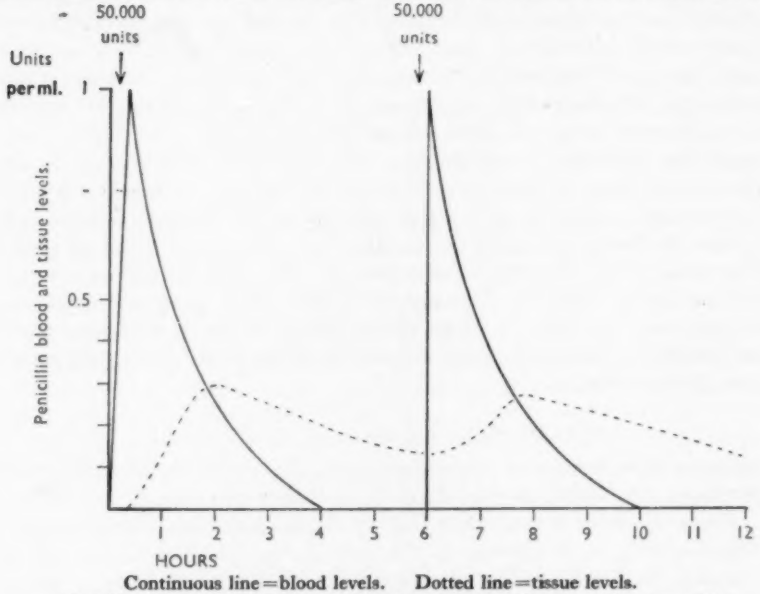
From this table it is obvious that by doubling the dose there is only a comparatively small increase in the time during which penicillin can be found in the blood. A dose of 15,000 units lasts for three hours or less: a dose of 1,000,000 units lasts for about twelve hours. Thus an increase in the dose of almost 70 times only increases the period of detectable penicillinæmia some four times. These figures show that the most economical way to use penicillin is the method of small doses frequently repeated, of which the continuous drip is the extreme example.

It is, however, impracticable when a patient is not hospitalized, to give more than two injections a day, and patients and doctors alike prefer only one. Many patients have been treated with doses of 100,000 units twice a day, and often the treatment has been successful. After such a dose, peni-

TABLE 1.

Dose	Time during which penicillin can be detected in the blood after intramuscular injection
15,000 units	2½ to 3 hours
30,000 units	3 hours
50,000 units	4 hours
100,000 units	5 to 6 hours
250,000 units	7 to 8 hours
500,000 units	9 to 10 hours
1,000,000 units	12 hours

cillin can only be found in the blood for five or six hours, so there is a gap of some six hours before the next injection, during which time there is less than a therapeutic level of the drug in the blood. It must be remembered,



Continuous line = blood levels. Dotted line = tissue levels.
Penicillin blood and tissue levels after intramuscular injection of 50,000 units.

however, that the microbes which are infecting the body are seldom in the blood stream. They are in the tissues, and it is worth a moment's consideration to see what sort of concentration of penicillin there would be in the tissues. The above chart illustrates what could happen.

When an intramuscular injection is given there is a rapid rise in the penicillin content of the blood. Then the penicillin diffuses from the blood to the tissues. The blood level falls rapidly, and in an hour or two there is equilibrium between the blood and tissues. The blood level continues to fall, and then there is diffusion back from the tissues to the blood. There must always be some period when penicillin exists in the tissues in effective concentration after it ceases to be detectable in the blood. Infected tissues are usually œdematous, and in such tissues it will take longer for the drug to diffuse in to its maximum, but equally it will take longer to diffuse out.

We had a patient with a streptococcal infection and a very œdematous leg. Following intramuscular injections of penicillin the penicillin levels were tested at intervals in the blood and in tissue fluid from the œdematous leg. The blood levels fluctuated as usual, rising soon after the injection and falling to nil before the next injection. The tissue fluid levels were almost constant, only varying between 0.4 and 0.5 unit per ml. during the whole day.

Florey *et al.* (1946) have shown that penicillin persisted in the fluid exuded from septic wounds for a considerable time after it had disappeared from the blood. More recently, Ungar (1950), working with rabbits, obtained similar findings. He created a necrotic focus by the injection of turpentine into the muscles of the hind leg. Then penicillin was injected intramuscularly into the muscles of the other leg. Blood and exudation from the necrotic area were examined at intervals with the following results:—

Dose: 30,000 units intramuscular	Time during which penicillin detectable in	
	Blood	Exudate
Aqueous penicillin	3 hours	8 to 9 hours
Oil-wax penicillin	12 hours	18 hours
Procaine penicillin	24 hours	31 hours

It will be seen that penicillin persists in the tissues (especially inflamed tissues) for some time after it has disappeared from the blood. It must therefore not be insisted that penicillin shall be in the blood all the time. The clinical results have often been excellent when there is a period between injections and when there is no measurable amount of penicillin in the blood, and the observations cited give one explanation of this. The interval between the injections must not be too long, however, and it is reasonable to suppose that with a quickly growing organism the interval should be shorter than with a slow-growing organism. I would suggest that in dealing with the common septic organisms it would not be wise to give less than 500,000 units if two doses a day are given, or less than 1,000,000 units if only one dose of soluble penicillin is given in twenty-four hours.

MEASURES FOR REDUCING THE NUMBER OF INJECTIONS

Methods other than merely increasing the dose have been used to diminish

the number of injections of penicillin. In 1945, Romansky incorporated *penicillin in arachis oil* and *beeswax*. When this was injected intramuscularly it formed a depot at the site of injection from which the penicillin was slowly absorbed. It was found that when 300,000 units of penicillin were so injected the penicillinæmia lasted for twenty-four hours, so that one injection daily was sufficient. Romansky's method was widely used, especially in the treatment of venereal diseases, but there were technical difficulties in making the injections unless the material was very carefully prepared. It had to be warmed before it could be taken into the syringe, and if there was any delay in making the injection the material solidified to the extent that it was impossible to inject it.

These technical difficulties made the advent of *procaine penicillin* very welcome. In the days when the commercial penicillin was relatively impure, procaine was often mixed with penicillin in the syringe to avoid pain. Then it was noticed that sometimes a precipitate formed, but this precipitate did not interfere with the efficacy of the drug. Later, procaine was deliberately added to penicillin solutions, the precipitate was collected and dried, and it is now used extensively in penicillin therapy.

PROCAINE PENICILLIN

Procaine penicillin is a powder which is only sparingly soluble in water. It can be suspended in water or oil, and when injected it forms a depot at the site of injection from which the penicillin is only slowly released. When it is liberated it is absorbed into the blood, and as it circulates, it diffuses into the tissues, but when it reaches the kidney it is excreted just like any other form of penicillin.

As the absorption is slow the blood level is never high, but it is persistent, so that after a dose of procaine penicillin of 300,000 or 400,000 units it can be detected in the blood in therapeutic amounts for twenty-four hours.

Procaine penicillin is issued by manufacturers in various forms:—

(1) As a suspension in oil.

(2) As a suspension in oil with aluminium monostearate.

(3) As a dry powder to which water is added to make a suspension immediately before injection.

(4) As a permanent suspension in a watery fluid.

(5) As a dry powder, in 300,000 or 400,000 units mixed with 100,000 units of sodium or potassium penicillin.

The usual daily dose is 300,000 or 400,000 units, which can be incorporated as a suspension in 1 ml. of oil or water.

At first the manufacturers had considerable difficulty in preparing procaine penicillin with crystals so small that they could easily be taken up in the syringe and expelled through a reasonably small needle, but now this has been overcome and there is no technical difficulty in the administration.

The first preparations were issued as suspensions in oil, and it was found that if 1 per cent. aluminium monostearate was added the absorption was still further delayed so that penicillin could be found in the blood for two days or more after an injection. As the absorption was slower, there was naturally a lower level in the blood throughout the period.

The most convenient method of using procaine penicillin is in a stable suspension in a watery fluid. This is put up in 10 ml. bottles, and all that has to be done is to shake the bottle to make sure there is an even suspension and then withdraw 1 ml. (containing 300,000 or 400,000 units) and inject it.

As the blood level following administration of procaine penicillin is always relatively low, a practice has grown up of combining this with sodium penicillin. Many manufacturers issue bottles containing 300,000 units of procaine penicillin and 100,000 units of sodium penicillin. One ml. of water is added to this, when the sodium penicillin dissolves and the procaine salt remains in suspension. When this is injected the sodium salt is rapidly absorbed and furnishes a high initial blood level which is maintained until the blood level from the procaine salt has reached its maximum. The same result could be obtained by making separate injections of the two salts, or by suspending the procaine salt in a solution of already prepared sodium salt.

Daily injections of the procaine salt make penicillin therapy easy, but in certain quarters the opinion is held that in some cases the clinical results are not so good as with the injection of the soluble salts.

PROLONGATION OF ACTION

Attempts have been made to prolong the action of penicillin by delaying its excretion by the kidney. It was early found that *p*-aminohippuric acid had some effect in this direction, but the most successful drug was 4′-carboxyphenylmethanesulphonanilide, marketed under the name 'caronamide'. This drug, taken orally every three hours in doses of 3 g., almost doubled the period of penicillinæmia after an injection. Apart from its causing pentosuria, there is no evidence that it produces any renal damage. As for its use in practical therapeutics, I might quote Garrod (1950):—

> 'The prolongation of therapeutic effect from a single dose of penicillin secured by administering Caronamide is not great; this is not a method for enabling a single dose to act for 24 or even 12 hours. The only clear present indication for its use appears to be the necessity for maintaining exceptionally high penicillin blood levels in treating infections due to resistant bacteria. It has thus been used, for instance, in treating subacute bacterial endocarditis when the responsible organism was unusually penicillin resistant'.

ORAL ADMINISTRATION

Oral administration has not been largely used in this country. In the early days of penicillin, when it was in short supply, this method was quite unsuitable. In their early papers the Oxford workers showed that the acidity

of the gastric juice destroyed much of the penicillin ingested, and even if this is overcome there is incomplete and irregular absorption from the alimentary tract. Some subjects absorbed it reasonably well, but there were some who absorbed only very little. If, however, ten times the ordinary dose of penicillin is given, most patients absorb sufficient to combat the ordinary infections, and now that penicillin is plentiful and relatively cheap there are occasions when oral administration might be an advantage.

The newer antibiotics, aureomycin, chloromycetin and terramycin, are normally given by the mouth and this is claimed as an advantage. These drugs are given in doses of 2 or 3 grammes a day. Three grammes of penicillin is equivalent to 5 million units, and if this amount of penicillin were given orally each day there are few individuals who would not absorb enough to deal with any ordinary infection. One would hesitate, however, to use this method in a desperately ill patient in case the absorption was faulty, or in patients with bacterial endocarditis or actinomycosis when very large doses may be required.

PENICILLIN RESISTANCE

Some bacteria are highly resistant to penicillin; some are extremely sensitive, and a few are midway. It was found early that in the laboratory a sensitive organism could be made resistant by continued exposure to sub-lethal doses, and it was feared that the misuse of penicillin would lead to a widespread dissemination of resistant forms. Fortunately this has not materialized, except perhaps with the staphylococcus.

In the days before penicillin was used clinically, I tested the resistance of large numbers of staphylococci taken at random, and it was uncommon to find a resistant one—certainly not more than 1 or 2 per cent.—but there were some that were naturally resistant.

Last year my colleagues, Hughes and Voureka (1949), tested the resistance of a large number of staphylococci taken from the noses of out-patients who came from widely separated districts, and found that some 8 per cent. were resistant. On the other hand, figures have appeared showing that almost 50 per cent. of the staphylococci from in-patients in hospitals where penicillin was extensively used were resistant. It seems likely that here the sensitive strains had been killed off, and in their absence resistant cocci which gained access could flourish. It is known that, unless extreme care is taken, a patient or a hospital attendant who is harbouring penicillin-resistant staphylococci can spread infection of these same cocci either directly or through dust to other patients, especially when the sensitive cocci have been removed by penicillin treatment.

It is impossible to say, however, that resistant strains cannot be induced by inadequate treatment; this possibility has to be borne in mind. Fortunately, in regard to staphylococci—and this is the only organism in connexion with which the development of penicillin-resistant strains has

been of any importance—there are other antibiotics which can deal with the situation, so that this problem is of less practical importance.

OTHER ANTIBIOTICS

This is an article on modern penicillin therapy, but it would be well to mention the newer antibiotics—aureomycin, terramycin and chloromycetin. All of these overlap somewhat with penicillin but there is general agreement that, at present, when the infecting organism is sensitive to penicillin, this is the drug of choice. They are all effective in gonococcal infections and to some degree in syphilis, but they are at present expensive and, in this country, scarce, whereas penicillin is plentiful and relatively cheap.

There may be circumstances in which an acute case, say a pneumonia, has to be dealt with in the absence of any bacteriological control. In such a case, when supplies are available, aureomycin or terramycin might be given with advantage, for not only do they act on the pneumococcus, but also on almost all the other organisms which might be responsible for the infection.

These antibiotics act on penicillin-resistant staphylococci, and if most of the staphylococci become penicillin-resistant, then aureomycin or terramycin may become first choice in staphylococcal infections until the time arrives that the staphylococci have become resistant to them, when a return to penicillin will have to be made.

CONCLUSION

During the last five years penicillin therapy has developed and become much less arduous to the patient and the doctor. There is no reason to suppose that we have reached finality, and doubtless new preparations will appear which will still further modify our methods.

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REVISION CORNER

THE TREATMENT OF CARBUNCLES

BEFORE discussing the actual treatment of carbuncles, the importance of excluding any other general disease, such as diabetes mellitus, cannot be overstressed. If diabetes is found to be present, steps should be taken to bring it under control by means of diet and insulin. It will often be found impossible to stabilize the diabetes fully until the carbuncle has cleared up, as any septic focus tends to make diabetes unstable. Nevertheless, the carbuncle will respond to treatment better if the associated diabetes is being brought under control. Once the carbuncle has cleared up, the patient will often be found to require considerably less insulin than during the course of the carbuncle.

PENICILLIN THERAPY

It is now true to say that the use of penicillin is the most important single line of treatment. It should be given by injection and in adequate doses. Severe carbuncles which require in-patient treatment respond best to three-hourly injections of about 50,000 units. Less severe cases, treated either as out-patients or in their own homes, respond well to injections of procaine penicillin in doses of about 300,000 units once or twice a day. There is no doubt that penicillin is extremely effective in the treatment of carbuncles. Spread of the infection is usually prevented, and the infection is overcome far more rapidly and certainly than was ever possible with any of the older methods of treatment. As a result of this, enormous carbuncles, often as much as 12 inches in diameter, which used to be seen, are now almost a thing of the past. Because the infection is brought under control more rapidly there is less suppuration and tissue destruction than in the past, so that healing is correspondingly more rapid. Such complications as septicæmia and pyæmia are seldom seen nowadays, except in untreated cases, and if they should have occurred, they are rapidly controlled. This excellent response to penicillin is due to the fact that carbuncles are almost always due to the *Staphylococcus aureus*, one of the organisms most susceptible to penicillin.

LOCAL TREATMENT

Local treatment in the early stages should be the application of some form of dry heat, and a hypertonic dressing such as magnesium sulphate or hypertonic saline. When the carbuncle has localized so that suppuration and tissue necrosis are taking place, 'eusol' is the best dressing, as it helps the separation of sloughs and prevents the appearance of septic spots and boils in the skin around the edges of the carbuncle due to the discharge. Once the sloughs have separated and the whole carbuncle has cleaned up to leave a granulating area, the application of a lotion, such as red lotion, will stimulate epithelialization and so aid final healing.

SURGERY

The question of the use of incisions in the treatment of carbuncles must now be considered. The use of a cruciate incision has been advocated, and it is stated that the incision must extend beyond the edges of the carbuncle into the adjacent healthy tissues. Advocates of this treatment said that it stopped the carbuncle from spreading, relieved pain and accelerated healing. All these arguments in favour of the use of cruciate incisions are erroneous, and the case against the use of this form of incision has been best stated by Sir James Paget in his 'Clinical

Lecture on the Treatment of Carbuncle', published in the *Lancet*, January 16, 1869. Paget pointed out that there is no way of telling in an early carbuncle whether it will spread or not. He described carbuncles which had spread even after he had performed cruciate incision, and we must all have seen such cases in our own experiences. Today we have a far better method of preventing the spread of infection in carbuncles than by cruciate incision, namely penicillin. Paget went on to point out that carbuncles are very painful in their early stages, but after a few days, when the infection has localized and suppuration has begun, the pain usually disappears to a great extent. Cruciate incision usually does relieve the pain in the early stages, but this can be done equally effectively by the use of morphine, which will only be required for a short time. The relief of pain is therefore no real argument in favour of cruciate incision. It is in the statement that cruciate incision accelerates healing that the most fallacious argument of all is used. Carbuncles treated conservatively usually discharge through several small holes, and the skin between these holes remains surprisingly intact. Once the sloughs have been discharged, this remaining skin falls in and often almost covers the resulting cavity, so that the lesion heals fully in a very short time. After cruciate incision, on the other hand, a large part of the four resulting skin flaps usually sloughs, so that a large cavity is left with insufficient skin to cover it.

This condemnation of cruciate incision must not be taken as condemning all incisions in the treatment of carbuncles. In some cases the carbuncle sloughs in its centre and pus accumulates under the slough and remaining skin. In these cases, simple incision of the skin and slough to let out the pocketed pus is often of great help.

CONCLUSION

As a result of the response of carbuncles to treatment with penicillin, the various older methods of treatment, such as autohæmotherapy, excision, the use of vaccines and sera, and the like, are mentioned only to be condemned.

To summarize the present position in the treatment of carbuncles, the use of penicillin is stressed, together with local treatment in the form of heat and hypertonic dressings in the early stages, 'eusol' dressings in the stage of suppuration and separation of the sloughs, and the use of red lotion in the healing stage. To this local treatment may be added the judicious use of simple incision to evacuate pockets of pus. Underlying general diseases, such as diabetes mellitus, must be looked for and treated.

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THE DIAGNOSIS AND TREATMENT OF NON-SPECIFIC URETHRITIS

The term 'non-specific urethritis' is often loosely used for any form of urethritis in which the gonococcus is not found in the discharge. This is a misuse of the term for there are certainly forms of urethritis in which specific bacteria, such as staphylococci, streptococci, diphtheroid bacilli, tubercle bacilli and other organisms can be presumed to be the cause. In any event the term is unsatisfactory because it implies that there is no specific cause for these infections, whereas the

probable truth is that there is a specific cause which has not yet been discovered. For these reasons the description 'abacterial urethritis' is preferable.

DIAGNOSIS

The common abacterial urethritis which is likely to be seen in general practice is that which is acquired in sexual intercourse and may be acute or subacute in its onset. The *acute form* has a short incubation period of one to five days and starts with profuse purulent or mucopurulent urethral discharge and dysuria, which may be severe. The mucous membrane at the external urinary meatus is reddened and the urine is hazy and cloudy with pus, which may be limited to the first glass if the two-glass test is performed. Occasionally in acute cases there may be a few drops of blood at the end of micturition, due to acute basal cystitis or posterior urethritis. The appearances may be indistinguishable from those of acute gonorrhœa. Smears of the urethral discharge examined microscopically show large numbers of polymorphonuclear leucocytes and no organisms, or very few. Diagnosis in these cases is by exclusion. The history and physical signs are characteristic and the only important differential diagnosis is acute gonorrhœa, especially when gonococci are scanty and hard to find. Gonorrhœa should only be excluded after careful and prolonged search, confirmed by negative cultures. Local complications, such as prostatitis, cystitis and epididymitis occur occasionally, and metastatic spread, resulting in arthritis, iritis and bilateral conjunctivitis, may follow.

The *subacute type* of abacterial urethritis, sometimes known as Waelsch urethritis, is more common. It has a longer incubation period, varying from ten days to a month or more, but some of the longer incubation periods may be due to the fact that patients sometimes overlook the condition because the symptoms are inconspicuous. The urethral discharge is often scanty and consists usually of clear mucus or mucopus. Dysuria is slight or absent. The first specimen of urine contains threads and is sometimes hazy. Smears of the discharge show polymorphonuclear leucocytes and epithelial cells with strands of mucus, but no, or few, organisms. Cultures are sterile or may contain a few colonies of organisms which normally inhabit the fossa navicularis. As with the acute form of the condition, the diagnosis is by exclusion of specific causes of urethritis, but the differentiation from acute gonorrhœa is usually easy from the history and physical signs. Local and metastatic complications may follow, as in the acute type of urethritis. In resistant or badly treated cases urethral stricture occasionally follows and may be a possible cause of relapse, to which this condition is very prone.

It is well to bear in mind that there are other causes of urethral discharge which must be considered in *differential diagnosis*, and these possibilities should receive special consideration when the urethritis tends to relapse or proves resistant to forms of treatment which are ordinarily successful. In particular it must be remembered that undiagnosed urethral stricture, chronic prostatitis, and also disease of the upper urinary tract, may present as an attack of urethritis. To begin treatment, particularly antibiotics or chemotherapy, in these cases before the diagnosis has been made may prevent accurate diagnosis and lead to great difficulty in the subsequent handling of the case and investigation of those to whom the infection may have been transferred. 'Diagnosis before treatment' is still the fundamental rule, which new methods of treatment have done nothing to invalidate.

Recently, certain specialized tests have been claimed to have significance in the diagnosis of this condition. The detection of certain bodies inside the cytoplasm of epithelial cells has been regarded as evidence that some of these cases are due to infection with a virus; others are perhaps due to pleuropneumonia-like organisms. Pleuropneumonia-like organisms have also been cultured from the secretions in some of these cases, but they are sometimes found in the normal urethra and it is not certain that they are pathogenic. These investigations are in the experimental stage and are of no value to the practitioner in the diagnosis of these conditions. It is stated, also, that the subacute or Waelsch urethritis can be distinguished, in the majority of cases, by the presence of white or greyish-white projections on the wall of the urethra seen by urethroscopy. This special examination is not likely to be available to the practitioner and, in any event, is inadvisable as a routine in early cases of urethritis.

TREATMENT

The acute form of the disease does not respond to the administration of penicillin, and the occasional case which does so is probably one of gonococcal urethritis in which the gonococci are scanty and have been overlooked. The possibility that both infections may be present in the same patient, resulting in partial response to penicillin, must also be borne in mind. In most cases the symptoms of discharge and dysuria are promptly relieved by the administration of sandalwood oil, which is best given by mouth in gelatin-coated capsules. Convenient dosage is 15 minims (0.9 ml.), three times a day after meals, or 10 minims (0.6 ml.) four-hourly for twenty-four to forty-eight hours. The urine clears subsequently with a satisfactory end-result and little tendency to recurrence. Intravenous injections of organic arsenicals have also given good results in these cases. Neoarsphenamine may be given intravenously, in dosage of 0.3 g. twice weekly, for four or five doses. Such treatment entails slight risk of toxic effects. Sulphonamides appear to be of small value, although they are not without some effect. In resistant cases they may be tried in the dosage recommended for the subacute type of infection. When other means fail, urethral irrigations may be given.

In the treatment of *subacute abacterial urethritis*, penicillin is of no value: but sulphonamides have a beneficial effect in some of the cases and are usually worth a trial. The less toxic preparations, such as sulphathiazole, sulphadiazine or sulphadimidine ('sulphamezathine') are preferable to sulphapyridine or sulphanilamide. Sulphatriad has the advantage of being less likely to produce renal complications. A satisfactory method of administration is to give 5 g. (ten tablets) daily for five days, giving 3, 2, 2 and 3 tablets after the four meals of the day, in that order. The tablets should be crushed or chewed, and large quantities of fluids, at least six pints in the twenty-four hours, should be taken during the period of treatment. Alkalis may be given in addition, but are not essential if the fluid intake is sufficient. There seems to be no benefit from continuing the tablets during the night hours, and nothing is to be gained by prolonging administration beyond five days. On the other hand, in resistant cases a second course of sulphonamide after an interval of one week is sometimes effective. The white cells of the blood should be counted before resuming treatment. Of the newer antibiotics, streptomycin is occasionally effective when given in dosage of 1 g. intramuscularly, once or twice daily for seven days. In this dosage for this length of time the toxic effects are inconsiderable. Preliminary experience with aureomycin

is favourable: 500 mg. should be given by mouth, six- or eight-hourly for four to seven days. Nausea, vomiting and diarrhœa give trouble occasionally, but most patients tolerate this dosage well.

Urethro-vesical irrigations with weak (1:10,000) warm (105° F. = 40.6° C.) potassium permanganate solution, given once or twice daily, are usually very effective in resistant cases but require care in technique and perseverance. It may be necessary to continue this treatment regularly for three weeks or more before success is attained. Good results have also been obtained with a similar technique using solution of oxycyanide of mercury (1:4000 to 1:8000).

Fever therapy by intravenous vaccine or by other methods often gives excellent results in resistant cases, but this is a procedure which requires experience and should only be given after admission to hospital.

After apparent cure these patients should remain under observation for three months, and receive adequate tests for residual infection.

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NOTES AND QUERIES

Prolonged Use of Chloral Hydrate

QUERY.—A married woman, aged twenty-nine, with one baby, suffers from insomnia. Since the age of fifteen she has had difficulty in going to sleep, but once she is asleep she does not waken exceptionally easily. Only very large doses of the barbiturates—three to four times the recommended dosage—will send her to sleep, and 3 to 4 grains (0.2 to 0.25 g.) of phenobarbitone daily make no difference. For six or seven years she has been taking 60 to 90 grains (4 to 6 g.) of choral hydrate every night. Without this she does not go to sleep before 3 a.m. There are no obvious psychological maladjustments. What are the dangers of such large doses of chloral when prolonged indefinitely? Is there any likelihood of a normal sleep rhythm becoming re-established?

REPLY.—In the days when choral hydrate was used extensively as a soporific, several examples of death apparently due to its prolonged employment were published. These deaths were attributed to sudden circulatory failure, explained by some as due to fatty degeneration of the heart, by others to paralysis of the vasomotor centre. It is suggested that tolerance to chloral may suddenly fail after the use of the drug over many years. The taking of 60 to 90 grains (4 to 6 g.) of chloral hydrate every night over a period of six to seven years is in my opinion hazardous, in spite of the fact that the drug is undoubtedly a safe one. Insomnia starting at the age of fifteen without any history of disease, such as encephalitis lethargica at that time, is almost certainly due to some psychological disturbance, and it would seem highly desirable to have an expert investigation of this possibility.

A. H. DOUTHWAITE, M.D., F.R.C.P.

Widal's Agglutination Test

QUERY (from Assam).—What readings would one expect in a Widal's agglutination test, against 'H', 'O' and 'V', during the pyrexial stage of: (1) A positive case of typhoid, or one of the paratyphoid group of fevers, in a patient who has (a) not had a prophylactic dose of T.A.B. vaccine; (b) has had this inoculation within twelve to twenty-four months. (2) A case of indefinite pyrexia (not of the enteric group of fevers) in a patient who has (a) not had a prophylactic dose of T.A.B. vaccine; (b) has had this inoculation within twelve to twenty-four months?

REPLY.—The results of the agglutination test in enteric group fevers depend upon the day of disease when the specimen is taken, and on the sensitivity of the suspensions used and the technique adopted. It is therefore impossible to give exact figures of the titres which might be expected or regarded as significant. Whenever possible, two samples of blood should be taken at an interval of five days and tested simultaneously. This should *always* be done in the case of an inoculated subject, as no significance can be placed on any single result obtained in

such circumstances. Any variation in the titres of the two specimens is of more importance than a high titre in a single test. With these provisos, the following may be taken as a rough guide, the answers being numbered to correspond with the query:—

(1a) H, 1/100 to 1/5000 or higher
O, 1/500 to 1/1000 or higher
Vi, unreliable, often negative. May be 1/10 to 1/50 (a control test using a standard serum must always be done in parallel).
(1b) As in (1a), but only a rise in titre is significant, and this may be anamnestic (see 2d).
(2c) Nil.
(2d) May be equal to (1b) in rickettsial infections, and occasionally in other pyrexias. In general, the reaction with O suspension is more specific than that with H. Unfortunately the O titre is often insignificant even in the conditions obtaining in (1a).

As a rule, the antibodies correspond to the infecting organism, i.e., the TO titre rises in infection with *S. typhi*, the AO in infection with *S. paratyphi* A. There is usually, however, a slight rise in heterologous agglutinins. Experience has amply demonstrated the fact that in inoculated subjects blood culture is the only reliable method of establishing a diagnosis in suspected enteric group infections.

BRIGADIER J. S. K. BOYD, O.B.E., M.B., CH.B., D.P.H.

Anti-V.D. Propaganda

QUERY (from a Service Medical Officer abroad).—Our V.D. rate is very high, due to the cheapness of the local brandy and to the opportunities present. I am supposed to lecture once a month to the station and all new squadrons arriving there. The lectures up till now have been of the blood and thunder type, with all the horrifying things that can happen as a result of V.D. I feel that few things in this life are achieved by fear, yet I am at a loss to know what other note to strike. I wonder if you can help me in any way, as the whole problem of V.D. here is becoming most worrying. Everything possible is, of course, done in the prophylactic line.

REPLY.—There appears to be little more than that stated that a single medical officer can do. It might be well to avoid 'blood and thunder' in lectures and concentrate rather on pointing out the immorality of fornication, a man's duty to his wife, girl friend or family, to his unit and to his country. What would he think if his wife or girl friend at home acted in a similar manner? It is generally accepted that the V.D. rate is always lower in a smart, well-disciplined unit than in a sloppy one; talks by combatant officers and N.C.O.s often effect more than those by medical officers. Cooperation with the Naval and Army authorities, and even more with the civilian ones, should give dividends. The more undesirable brandy shops and brothels might be put out of bounds and the others carefully watched by Service police.

In the long run 'contact tracing' is likely to produce better results than any other single method, combined as it should be with treatment of infected civilian women: for this latter, civilian authorities may require to be supplied with medicaments, especially penicillin and sulphonamides. Service medical officers might even give a hand in civilian clinics.

As regards prophylaxis, consideration might be given to administering a dose of, say, 300,000 units of penicillin orally to *every* Service man returning late to camp or barracks; this should be quite harmless if steps are taken to have the necessary blood tests carried out in order to reveal a deferred attack of syphilis; it may even be that such a procedure would kill any spirochætes as well as gonococci which had gained entry within the previous hour or two.

T. E. OSMOND, M.B.

Normal Posture or 'Stance'

QUERY.—Authoritative works on physical medicine define normal posture on the basis of a plum-line drawn from the mastoid process. There are slight variations in definition in that one authority particularizes that the knee joints are in extension, whereas another makes no mention of this, but is more precise about the distance the plum-line should fall in relation to the ankle joint. Attention is also drawn to the pelvic inclination. Can you tell me what is the basis for this definition, and what studies have been made with a view to discovering a rationally based normal posture, and if these extend to posture in other positions, and in movement?

REPLY.—'Authoritative' works on physical medicine are singularly lacking in knowledge of the mechanism of the human body. Most of them confuse posture, attitude and stance. Posture is the neuromuscular mechanism whereby the subject keeps the world right side up to him by keeping himself right side up to the world. This posture is maintained by the coordination of four groups of sensory stimuli from the semicircular canals, the proprioceptive nerve endings in muscles, the visual fields, and sensory endings in the sole of the foot. The term 'posture' should be reserved for this physiological mechanism. The position in which a person stands should not be called 'posture' but 'stance'.

The common types of stance are: (1) the normal, (2) the relaxed, (3) the military. These three types can be analysed in terms of anatomy

and mechanics, bearing in mind that the vertical line through the centre of gravity of the body is all-important.

(1) This normal stance is one in which the centre of gravity of the head and trunk is over the common axis of the hip joints. The centre of gravity of the head, trunk and thighs is vertically over the knee joint axis. The centre of gravity of the body above the ankle joint is over the joint. This position is only maintained with ease for a few moments and is essentially an 'attitude' rather than a 'stance'. Converting this from anatomy to physiology it may be said that an attitude involves posture on the verge of change.

(2) The relaxed stance is one in which the spine is inclined slightly forwards and no active muscle tension of the extensors of the trunk is necessary for balance. The head is slightly flexed so that the horizontal semicircular canals are truly horizontal.

(3) The military stance or 'Preussische Gestalt' is totally artificial. The thorax is carried forward, the chest thrust out, the abdomen drawn in, and the inclination of the pelvis is increased. The centre of gravity of the body is thrown in front of the ankle joint and in front of the knee joint, so that tension of the calf muscles is increased. The lumbar lordosis is magnified. The horizontal semicircular canals are tipped upwards to make an angle of about 25° with the horizontal.

The sound stance is that which interferes least with breathing, digestion, and the circulation of blood and lymph. The mastoid process has nothing to do with the problem, for it may be large or small, or totally undeveloped as in the babe.

PROFESSOR H. A. HARRIS, M.D., D.SC., M.R.C.P.

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Treatment of Peripheral Arteriosclerosis in Diabetes

QUERY.—A patient of mine is suffering from peripheral arteriosclerosis, the result of neglected diabetes. I would be interested to know the latest views with regard to treatment, having special reference to the value of diathermy and the use of the intermittent venous occlusion machine. Have the results attributed to the latter apparatus been substantiated, or are they psychological in origin?

REPLY.—The association between arteriosclerosis of the peripheral vessels, especially of the legs, and diabetes is well recognized and treatment depends very largely upon the degree to which the blood supply is interfered with. For intermittent claudication, Buerger's exercises, vasodilator drugs, such as 'priscol', and vitamin E in the form of 'ephynal', sometimes prove helpful, and intermittent venous occlusion may prolong the walking distance provided that the patient himself has the necessary apparatus and uses it daily. Severe degrees of intermittent claudication have been treated by various operative procedures, of which tenotomy of the Achilles tendon, as advocated by Professor Boyd, seems to give the best results. When arteriosclerosis gives rise to ischæmic changes in the toes, the treatment will depend upon the presence or absence of gangrene, sepsis, and the like, and each case requires individual consideration. There is no evidence that diathermy produces any lasting improvement in cases of peripheral arteriosclerosis.

WILFRID OAKLEY, M.D., F.R.C.P.

Desensitization to Bee Venom

QUERY.—I should be grateful if someone who has seen long-term results of desensitization to bee venom, could advise on how to manage this case :—

A man aged sixty-four, has worked on the same estate for fifty years; there is a large apiary at no great distance. He has been stung on a number of occasions with no ill-effect until last year when, following a sting over the mastoid, he had a dangerous reaction with loss of consciousness for half an hour. The same thing has happened again this summer.

REPLY.—This patient gives the usual story of previous stings causing no trouble for a number of years, when suddenly, for some unknown reason, he became sensitized. This sensitivity in varying degrees to bees, and probably wasps and ants, will remain with him for the rest of his life. It is due to bee protein rather than to some particular property of venom. No very convincing account of desensitization to bee sensitivity has appeared, although many attempts have been made by giving injections of increasing amounts of the bee venom or a bee extract. Protection, if afforded, may last only when an adequately high dosage has been reached and for so long as the injections are continued. The antihistaminics, such as benadryl, by mouth are of no help in patients with a marked sensitivity. Self-administered adrenaline is the method of choice in treatment. A sting may cause unconsciousness within five seconds, and can be fatal.

A. W. FRANKLAND, B.M.

PRACTICAL NOTES

Treatment of Post-Partum and Menopausal Obesity

A REPORT of the results obtained in the treatment of 34 cases of post-partum and menopausal obesity is given by H. Halper (*Medical Journal of Australia*, August 12, 1950, **37**, 246). The ages of the patients ranged from twenty-six to fifty-one years: 29 had cervical infection and 5 cervical tears or erosions; in addition 7 had hyperostosis frontalis interna. Following cervical examination, X-ray examination of the skull and pituitary fossa, and estimation of the basal metabolic rate, the patients were divided into three groups: (1) post-partum; (2) menopausal; (3) hyperostosis frontalis interna. In those cases with cervical infection, antibiotics, sulphathiazole and local therapy were given for the first week, the patients taking their usual food except for the elimination of sugar and sugar-containing foods. After the first week, antibiotics were stopped, and the patients were given a 1,500 calorie diet with high protein and low carbohydrate content, minimal fats, and fluid restriction to about 3 pints per day. In addition they received dextro-amphetamine sulphate, 5 mg. twice daily. The patients with menopausal symptoms were given small doses of ethinyl œstradiol and 1/10 grain (6.5 mg.) of thyroid. The dietary and amphetamine regime was carried out in all cases for four weeks: 6 cases defaulted. Average weight loss per week was:—Group I, 2½ pounds; Group II, 2 pounds; Group III, 1 pound. A further period of two months' treatment was then instituted with the same dietary restrictions; dextro-amphetamine was stopped for two weeks and then resumed in dosage of 5 mg. per day in two divided doses. Total weight losses for the three months' period were: Group I, 23 pounds; Group II, 21 pounds; (3) Group III, 8 pounds.

Treatment of Eclampsia

THE following are some of the important practical points from 'a preliminary report on the present Rotunda treatment of eclampsia' by the Master of the Rotunda (O'Donel Browne: *Journal of Obstetrics and Gynæcology of the British Empire*, August 1950, **57**, 573). An initial dose of 0.5 g. sodium thiopentone in 10 ml. of distilled water is given intravenously. This is to prevent further fits while a thiopentone-dextrose drip (3 g. thiopentone in 1 litre of 10 per cent. dextrose without saline) is being prepared. If crystals appear with this combination, it is discarded and a fresh solution is made by dissolving 3 g. thiopentone in 5 per cent. dextrose. The aim of this treatment is to control convulsions, and the correct rate of flow can be assessed from the following figures:—

Rate of flow: drops per minute	Hours taken for 1 litre to run	Litres per 24 hours	Sodium thiopentone per 24 hours
15	22	1.09	3.27
20	16	1.5	4.5
25	14	1.8	5.4
30	11	2.16	6.5

It is 'most important' to limit the 24-hour fluid intake to 1 to 1.5 litres. If convulsions are not controlled by this dosage, it can be supplemented by injecting 2 ml. (0.1 g.) of sodium thiopentone from the syringe into the tube, when necessary. 'The care required during labour does not differ from that necessary with other forms of sedative treatment, except that more careful supervision is necessary, as labour may not be noticed'. When pains occur, it is safe to give a further injection of 2 ml. of thiopentone (0.1 g.) intravenously into the tube. Penicillin is given prophylactically as a routine measure to protect against the risks from sepsis, pneumonia and puerperal infection. Among 18 cases treated by this method there has been one death, a maternal mortality rate of 5.5 per cent., and five stillbirths.

Prognosis of Pneumonia in Infancy and Childhood

A STUDY of the prognosis of pneumonia in 214 infants and children admitted to two Manchester hospitals during 1946-48 (inclusive) has been made by A. Holzel and B. Wolman (*Archives of Disease in Childhood*, September 1950, **25**, 282). The over-all mortality for the series was 17 per cent. (33 of 194 cases). Excluding cases under six months of age, however, the mortality was only 4 per cent. (5 of 118 cases), whilst the mortality rate among infants under six months of age was 36 per cent. (28 of 76 cases). In children over one year of age the mortality was down to 1.3 per cent. (1 of 77 cases). A further analysis of the cases under the age of six months showed that the mortality rate in the sulphonamide-treated group was 27 per cent. (5 of 18 cases), whilst among those treated with a combination of sulphonamides and penicillin it was 30 per cent. (11 of 36 cases). An analysis of the records of the 20 children who died within twenty-four hours of admission to hospital showed that 15 were under the age of six months, and all of these were artificially fed. Another interesting observation was that leucocyte counts in 80 infants under the age of two years showed that no prognostic significance could be attributed to the total white count or to the polymorpho-

nuclear percentage. The lesson drawn from this investigation is that 'attempts to lower the general mortality from pneumonia must be directed towards the treatment during the first six months of life'.

Rectal Pentothal for Tonsillectomy in Children

A COMPARISON has been made by J. F. Artusio and M. Trousdell (*Anesthesiology*, July 1950, **11**, 443) of 100 tonsillectomies in children, 50 of whom received pentothal sodium rectally as basal anæsthesia (series I), and 50 received morphine and atropine as premedication (series II). The children in series I received atropine sulphate one hour before operation, and pentothal sodium (0.2 ml. of a 10 per cent. solution per lb. of body weight) per rectum half an hour before operation. This was followed by open drop ether and then insufflation of ether and oxygen. The children in series II received morphine sulphate and atropine sulphate, followed by induction of anæsthesia with open drop vinethene, ether sequence and insufflation of ether and oxygen. The average age of the children was five years. In series I the average time for the child to fall asleep after pentothal was seven minutes, the average time of total anæsthesia was one hour, and the reaction time was 60 to 120 minutes; smooth induction was obtained in 43 cases. In series II the average total anæsthesia time was 30 to 40 minutes, and the reaction time was 30 to 50 minutes; smooth induction was obtained in 40 cases. Post-operative vomiting occurred in 22 per cent. of those in series I and in 54 per cent. of those in series II. In 92 per cent. of those in series I the last thing remembered was receiving the enema, whilst 94 per cent. of those in series II had definite memories of the administration of the anæsthetic. Ten days after operation only 4 per cent. of those in the pentothal series considered that their stay in hospital had been unpleasant, compared with 30 per cent. of the morphine-atropine series. There were no anæsthetic complications. No instance of laryngospasm occurred. It is concluded that both these methods are satisfactory, but that rectal pentothal has the advantage of being more pleasant for the child and of producing less psychological trauma.

Dehydrated Banana in Diarrhœa in Infants

As a result of their experience in 20 cases, J. H. Fries *et al.* (*Journal of Pediatrics*, September 1950, **37**, 367) 'conclude that the use of dehydrated banana flakes provides a method of choice in the treatment of nonspecific diarrheas of infancy'. The preparation of dehydrated banana which was used contained 83.48 per cent. protein, 6.87 per cent. carbohydrate, 1.3 per cent. fat, an 'appreciable amount of vitamins and minerals', and only 5 per cent. moisture. It was given to 20 children whose ages ranged from one month to one year, and who were admitted to hospital for 'a primary diarrhea of nonspecific origin, for which there was no indication for sulfonamides or antibiotics'. The children were given one level tablespoonful (6 g., 23 calories) of dehydrated banana flakes per lb. (543 g.) of body weight per twenty-four hours. Each tablespoonful was diluted with 2 ounces (60 ml.) of water (a dilution of 1:2). The total amount calculated for the day was divided into nine feeds given two-hourly from 6 a.m. to 10 p.m. and at 2 a.m. Boiled water was given frequently between feeds. After two to three days' treatment with improvement occurring, a transitional diet was given which, in the case of infants, consisted of giving the banana flakes in 5 to 7½ per cent. skimmed milk. The dehydrated banana was liked by the children and did not produce any gastro-intestinal irritation. Within twenty-four hours there was a marked improvement; and the average time for complete recovery was 2.9 days, compared with 5.02 days in a control group of 20 comparable cases treated by the ordinary routine hospital procedures. At the end of seventy-two hours, 17 of the cases were classified as showing a 'good' response, i.e. formed stools and not more than three or four a day, compared with 7 in the control series. Gains in weight during the acute phase of the illness were recorded in 16 of the children treated with banana, compared with only 7 in the control group.

Treatment of Subacromial Bursitis

DURING the period 1942-49, 485 cases of subacromial bursitis were treated at the Oschner Clinic, Louisiana (G. A. Caldwell and B. M. Unkauf: *Annals of Surgery*, September 1950, **132**, 432): 28 per cent. acute; 31 per cent. subacute; 41 per cent. chronic. Injection of 1 per cent. solution of procaine hydrochloride into the skin, muscle and bursa, followed by multiple punctures of the tendon near its insertion into the tuberosity, resulted in complete relief of some of the acute symptoms; this procedure was also employed with success in some subacute and chronic cases. Physical therapy, in the form of heat, gentle massage and exercises, was given in most cases; and X-ray therapy proved effective in the initial attacks of the acute stage. Operative measures, i.e. incision of the bursa and supraspinatus tendon with removal of cal-

cified deposits, were reserved for the most acute cases, those which had failed to respond to conservative measures, and chronic recurrent cases. Follow-up reports in 340 cases gave the following results:—Conservative measures resulted in satisfactory relief of pain and restoration of a useful range of movement in 70 to 85 per cent. of cases. X-ray therapy proved effective in relieving pain due to tension within the supraspinatus tendon in 85 per cent. of cases. Physical therapy is a necessary adjunct to treatment, and in many subacute or mild chronic cases proved to be adequate without any other form of therapy. In 7 chronic cases manipulation under anæsthesia was employed: the results were not good, 4 being graded 'fair', and 3 'poor'. It is stated that 'recurrent attacks are to be anticipated in 22 per cent. of cases following acute or subacute symptoms, and in 33 per cent. of patients with chronic symptoms'. Finally, 'the longer symptoms have persisted the poorer the outlook for relief by conservative measures'—in 33 per cent. of chronic cases the results were poor.

Dyspareunia

THE causes and treatment of dyspareunia are discussed by Clifford White in the *Medical Annual* 1950, **68**, 87. Dyspareunia may be superficial, deep, or of psychological origin; also it may be primary or acquired, i.e. present since marriage or coming on after years without pain. Primary superficial dyspareunia has several causes: unruptured hymen or ruptured hymen in a very small vulva; vaginitis; congenital short vagina; congenital elongation of the cervix; tubo-ovarian swellings; vaginal cysts or fibroid polypi. Another type of superficial primary pain is due to difficulty of penetration due to a narrow vulval orifice. The acquired type of dyspareunia may be due to caruncle, kraurosis, prolapse of uterus, anal fissure, or hæmorrhoids; examination of the anal region should never be omitted. In the treatment of a tight hymen dilatation with the fingers under an anæsthetic may prove sufficient; coitus should be avoided for forty-eight hours and an anæsthetic lubricant used when again attempted. If the patient is not seen for a month or two after marriage this procedure may not produce cure, and operation for removal of the hymen, with stretching of the vulva to separate the cut ends of the muscles, and then stitching of the skin to the vaginal wall may be required. From the psychological point of view it is important for the patient to seek medical advice early. After-treatment consists in the patient passing warmed, lubricated glass dilators of graduated sizes into the vagina. For the cases due to congenital short vagina all that can be done until pregnancy occurs is to instruct on posture during coitus. Glass dilators are also used in the treatment of narrow vulval orifice. In psychological cases it is necessary to find whether the fear of pregnancy is behind the complaints; in severe cases the help of a psychiatrist may be necessary.

Treatment of High Blood Pressure with Hexamethonium Iodide (C_6)

A SERIES of cases of hypertension, including benign essential hypertension (7), malignant hypertension (4), chronic glomerular nephritis (2), and acute hypertension of pregnancy toxæmia (1), has been treated with hexamethonium iodide (C_6) by P. A. Restall and F. H. Smirk (*New Zealand Medical Journal*, June 1950, **49**, 206). Effectual dosage varied with the individual patient, route of administration, and position of the patient, i.e., with equal doses the more vertical the patient the greater the effect. Using the halogen salt, the minimum effective dose required was: 3 to 20 mg. intravenously; 5 to 150 mg. subcutaneously. Intramuscular injections of either aqueous solution or suspension in almond oil were also employed; the dose of the oily suspension seemed to be about two to four times that of the aqueous solution. Duration of the main effect upon blood pressure depended on dosage, but was usually one hour with intravenous injection, three to four hours with subcutaneous injection, and up to twelve hours with intramuscular injection of oily suspension. Mild hypotensive symptoms in the form of yawning, dizziness, darkened vision, faintness, pallor and nausea occurred in some cases; and sensitivity to the drug was noted in patients following the Kempner rice diet, causing dangerous hypotension in one case. The maximum effect of the drug was usually felt some twenty-five minutes after subcutaneous injection, and sitting during this period helped in some cases to prevent hypotensive symptoms. The blood pressure falls produced by C_6 with the aid of posture ranged from 40 to 120 mm. of mercury in the systolic, and from 15 to 80 mm. of mercury in the diastolic. In three cases of malignant hypertension there was disappearance of papillœdema and retinal œdema with cessation of hæmorrhages in one, reduction of papillœdema and cessation of hæmorrhage in another, and complete clearance of papillœdema in one eye with lessening of hæmorrhage in the third (this patient relapsed following pneumonia). It is stated that a dosage scheme of two to three subcutaneous injections daily, with the aid of posture, should permit moderate exertion or a sedentary occupation.

REVIEWS OF BOOKS

Dawson of Penn. By FRANCIS WATSON. London: Chatto and Windus, 1950. Pp. 344. 18*s*.

AMONG the many wise customs of the Mother of Parliaments is one that no statue shall be erected within its precincts to the memory of a former member until at least ten years after his death. A similar rule might well be applied to the biography of public figures, in order to ensure that the subject of the biography can be seen in a correct perspective. Lord Dawson was a complex personality, and it is no criticism of Mr. Watson's skill as a biographer that he has not succeeded in presenting a really satisfying biography. As a sketch it has many attractions, but it is not a full-size portrait. For that we shall need to wait some little time yet, and the task will require an intimate knowledge of the medical profession, as well as of matters of State. It says much for this biography that it whets one's appetite and stimulates one's curiosity. What manner of man was this? What will be his final niche in the history of these Islands? Will he go down to history as a great court physician, a medical statesman, an administrator, or a great physician? What was his secret of success? Was it his understanding of human nature and his capacity for taking infinite pains in his dealings with patients? Was it a gift for knowing when to act and when to maintain masterly inactivity? Or did he possess the gift of being able to see one step ahead of his contemporaries? These are some of the questions aroused by this biography. To those who did not know Dawson, this life will reveal many interesting facets. His difficulty in passing examinations, and the almost laborious care which he had, throughout his entire life, to devote to the preparation of public speeches. If any additional evidence were necessary for this, it is to be found in the persistent splitting of infinitives which distinguishes his earlier letters and diaries. Then there is the index of jokes which he kept so as always to have a suitable one for any occasion, and his lessons in public speaking. To the general public Dawson's name will always be associated with his attendance upon King George V in his serious illness of 1934, and in his final illness, and both these episodes are dealt with fully. By the medical profession, particularly at the present day, he is probably best remembered by the 'Dawson Report' of 1920, outlining a national health service, the essential unit of which was to be health centres. The tragic tale of the pigeon-holing of this statesmanlike document is told here, but not with the detail it deserves.

Written in an attractive style, this book makes for easy reading. It will appeal to all doctors as well as to laymen interested in the social history of the last fifty years. For such it will make an ideal Christmas present.

Modern Trends in Obstetrics and Gynæcology. EDITED BY KENNETH BOWES, M.D., M.S., F.R.C.S. London: Butterworth & Co. (Publishers) Ltd., 1950. Pp. xi and 778. Figures 139. Price 60*s*.

As the title indicates, this is not a textbook of obstetrics and gynæcology. Rather it deals with those aspects of obstetrics and gynæcology in which knowledge has advanced during recent years, and with those fields of medicine and science in which recent developments have an important bearing on obstetrics and gynæcology. The range of subjects covered is wide. From the biology of menstruation to the influence of social class on stillbirths and neonatal deaths; from radioisotopes in research and the present knowledge of pituitary trophins and of steroid hormones, to the treatment of uterine cancer and the law in relation to obstetrics and gynæcology; no advance in knowledge of interest to the obstetrician or gynæcologist appears to have been omitted. Each of its fifty chapters comes from an authoritative source. The writers are mainly British, but eminent American, Commonwealth, and European authors have also contributed. In quality the subject matter is of the standard which the reader would expect from so distinguished an array of authors, and there are excellent lists of references. The consultant, teacher and non-teacher alike, will find this beautifully produced book full of interest, as also will candidates for higher examinations. The general practitioner will find certain chapters instructive but the book as a whole is more likely to attract the specialist.

Clinical Nutrition. EDITED BY N. JOLLIFFE, M.D., F. F. TISDALL, M.D., and P. R. CANNON, M.D. New York: Paul B. Hoeber Inc.; London: Cassell & Co., Ltd., 1950. Pp. xvi and 925. Tables 78. Figures 127, 61 in colour. Price 90*s*.

THIS handsomely produced book, published under the auspices of the National Research Council of the U.S.A., is illustrated with beautiful colour plates of clinical disorders,

some of which, however, have no nutritional significance. The thirty-six contributors include some of the most eminent men in the field of nutrition. Yet, as so often happens in ambitious symposia of this kind, the result is disappointing. It is intended for use by 'the family physician, student and specialist', but its arrangement in chapters according to chemical nutrients rather than human ailments limits its value as a book for practical reference. It is essentially an American view of human nutrition, with emphasis on the contributions of American research; the work of R. A. Peters, for instance, is dismissed by a reference to a Dr. Stotz. A world-wide nutritional disease—kwashiorkor—is not mentioned. Every library should have this book because of several distinguished contributions and its useful references. But practitioners in countries with serious nutritional problems may find it disappointing.

Principles of Ophthalmology. By THOMSON HENDERSON, M.D. London: William Heinemann (Medical Books) Ltd., 1950. Pp. 230. Figures 63. Price 20*s*.

IN this volume Dr. Thomson Henderson expounds his theories of the physiology of the eye. He postulates a suprachoroidal space the contents of which, by free passage through the angle of the anterior chamber, are in hydrostatic equilibrium with the intraocular fluid; so that the choroido-retinal layers float, as it were, in a continuous medium in a manner analogous to that in which both surfaces—the ventricular and the cortical—of the cerebral hemispheres are subjected to an equilibrated pressure through the foramen of Magendie. The intraocular pressure, at its accepted figure of 25 mm. of mercury, is held to be the result of experimental manipulation—the reaction of the intraocular contents and circulation to the sudden change of pressure caused by the introduction of the cannula—whereas the physiological pressure is 10 mm. of mercury. It must be admitted that this is one of the most convincing sections of the book. A new theory of accommodation is put forward, and the etiology of primary glaucoma is simplified as being due to sclerosis of the cribriform ligament. It is good that accepted theories should, from time to time, be bombarded, even if the missiles are provocative and sometimes bizarre, and many of the author's theories are sufficiently ingenious and strongly argued to sharpen the wits of those who attempt to refute them. The book is illustrated with a series of micro-photographs of the angle of the anterior chamber in many animals from the camel to the kangaroo.

Asphyxia Neonatorum: Its Relation to the Fetal Blood, Circulation and Respiration and its Effects upon the Brain. By WILLIAM F. WINDLE, PH.D., SC.D. Springfield, Illinois: Charles C Thomas; Oxford: Blackwell Scientific Publications Ltd., 1950. Pp. vii and 70. Figures 9. Price 15*s*.

THIS monograph in the American Lecture Series represents the revised text of a notable series of lectures on fœtal and neonatal respiration. Professor Windle's book on the 'Physiology of the Foetus', first published in 1940, contributed much to a more general understanding of this field, particularly the fascinating subject of fœtal respiration. Now much additional knowledge derived from his own experiments and those of others has been incorporated in this monograph on asphyxia neonatorum. It is still not sufficiently appreciated that fœtal anoxia causes more fœtal and neonatal deaths than any other condition, and is a major cause of cerebral palsy and mental defect. The value of this monograph by a leading authority on fœtal respiration can therefore scarcely be exaggerated.

Bakteriologie und Serologie. By DR. LOTHAR HALLMANN. Stuttgart: Georg Thieme Verlag, 1950. Pp. xi and 644. Figures 240. Price D.M. 29.70 ($7.0).

THIS book, although of small size, treats in a comprehensive manner the theoretical and practical aspects of bacteriology and serology. In addition to a good systematic description of the morphological and biological characters of the various micro-organisms, including protozoa, an account is given of the various methods of bacteriological and serological investigation. There are many illustrations throughout the book, some of which are very good, and numerous diagrams and tables. In addition, there is a section dealing with general laboratory investigations, and an appendix showing the composition of culture media, staining reagents and other materials used in laboratory work. This is a useful work, especially for the practical laboratory worker.

Thank God for My Heart Attack. By CHARLES YALE HARRISON. Kingswood, Surrey: The World's Work (1913) Ltd., 1950. Pp. 156. Price 7*s*. 6*d*.

IT would be easy to criticize this book in detail, especially where the author ventures into pathology, but allowing for its popular style and for the euphoria of convalescence there is much in it that rings true. Its principal interest lies in the

big part that psychiatry played in his recovery. That it is an inner power that saves in the critical days following coronary thrombosis is quite probable in the light that the discovery of cortisone has thrown on the mechanism of resistance. As an authentic account of the subjective features of coronary thrombosis it is an interesting contribution to our knowledge.

NEW EDITIONS

Savill's System of Clinical Medicine (Edward Arnold & Co., 35*s*.), the thirteenth edition of which is now published, is a logical system, but a difficult one to translate into the form of a textbook. It is an outstanding tribute to Dr. T. D. Savill that his textbook, still unique in its approach, should remain a firm favourite. Much of the credit for its persisting popularity is undoubtedly due to the skill of the Editor, Dr. E. C. Warner. The essential feature which differentiates it from other textbooks of medicine is that it starts from symptoms, integrates them with physical signs, so reaching the diagnosis, which is then followed by treatment. This is, of course, the logical approach, and the result is a textbook which anyone who has once used it, will never forsake. Under present rather standardized methods of qualifying examinations it may not be the book from which to learn medicine, but it is certainly the book which will prove most valuable to the senior undergraduate and to the postgraduate. Dr. Warner and his colleagues, of whom there are now seventeen, are to be congratulated on the skill with which they have integrated recent advances into the original scheme.

Congenital Heart Disease, by J. W. Brown, M.D., F.R.C.P. (Staples Press, 30*s*.), in its second edition, has been largely rewritten, but, fortunately, the author has been able to maintain its essentially clinical characteristic. Dr. Brown is in the true tradition of Mackenzie and Pickles—the general practitioner who quietly, but by careful and acute clinical observation, has acquired an outstanding knowledge of the subject of which he has made a special study. This is no theoretical textbook culled from the writings of others. Such writings are not ignored, but they are carefully and critically integrated with his own series of cases systematically observed over a long period of time. In this new edition full attention is paid to the dramatic advances which surgery has contributed to the treatment of congenital lesions of the heart. For the clinician this is one of the best books on the subject. It may not have the wealth of physiological data based upon complicated methods of investigation such as angiocardiography and cardiac catheterization, which now tend to monopolize any discussion of the subject, but it is packed full of those sound clinical and pathological data, without which this small, but fascinating, branch of cardiology can never be fully appreciated.

WHEELER and Jack's *Handbook of Medicine*, revised by Robert Coope, M.D., B.SC., F.R.C.P., in its eleventh edition (E. & S. Livingstone Ltd., 20*s*.) has been extensively rewritten, and the many important advances in medicine since the appearance of the previous edition in 1937, have been incorporated. Written specifically for the student as a guide to his work in the wards, the book ably fulfils this aim: emphasis is on the pathology, etiology and diagnosis of disease rather than treatment, although ample sections on prophylactic and therapeutic measures are included. The book, which is of convenient size, covers a wide field, and practitioners also may find it a useful addition to their everyday armamentarium.

THE second edition of Volume II of *The British Encyclopædia of Medical Practice* (Butterworth & Co. (Publishers) Ltd., 60*s*.) ranges from 'aphasia' to 'boils and carbuncles'. Thus, it contains such important topics as arthritis and high blood pressure. Six sections are allotted to arthritis, but it is difficult to understand why almost twice as much space is devoted to osteo-arthritis as to rheumatoid arthritis. Two outstanding sections are those on atomic energy by Dr. J. F. Loutit, and on aviation medicine by Sir Harold Whittingham. Mr. Tucker's section on athletic injuries is commendably practical. The section on boils and carbuncles suffers from being too inclusive in its outline of treatment. Two other sections worthy of special mention are those by Dr. Macdonald Critchley—on aphasia and apraxia.

Textbook of X-ray Diagnosis. Vol. III, edited by S. C. Shanks, M.D., F.R.C.P., F.F.R., and P. Kerley, M.D., F.R.C.P., F.F.R., D.M.R.E., in its second edition (H. K. Lewis & Co. Ltd., 70*s*.) will receive universal welcome. It contains sections on the alimentary tract, the biliary tract, the abdomen and the urinary tract, and the use of radiology in obstetrics and gynæcology. New authors are Dr. Kemp Harper, who writes on the radiological examination of the abdomen, and Dr. A. J. Johnston, who contributes the section on the pharynx and œsophagus. This volume is well produced, and is one of which British medicine may well be proud. No library can afford to be without it.

The contents of the January 1951 issue, which will contain a symposium on 'Rheumatic Diseases', will be found on page lxiv at the end of the advertisement section.

Notes and Preparations, see page 659.
Fifty Years Ago, see page 663.

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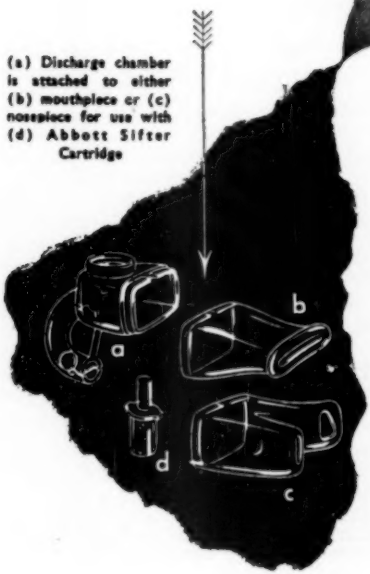

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For oral inhalation the patient simply attaches the mouthpiece (b), inserts a cartridge of penicillin powder (d), and inhales, removing the apparatus right away from the area of the mouth when exhaling. Nasal inhalation is similar, using the nosepiece (c). The patient's respiration is the only motive power necessary.

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* The Inhalation of Penicillin Dust, *J. Amer. Med. Assn.* 138 : 344, October 2, 1948.

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NOTES AND PREPARATIONS

NEW PREPARATIONS

'AVOMINE' brand promethazine-8-chlorotheophyllinate has been prepared for the control of nausea and vomiting, and especially travel sickness. Large-scale clinical trials in seasickness are claimed to indicate considerable benefit in a high proportion of cases, and it has been found useful for the prevention of travel sickness in children, and in women in the early stage of pregnancy. Issued for prescription in containers of 10 tablets of 25 mg. (May & Baker Ltd., Dagenham, Essex.)

'BUFFERED CRYSTALLINE PENICILLIN G', POTASSIUM SALT, DC(B)L.—In the preparation of this solution, 4.5 per cent. anhydrous sodium citrate has been added as a buffering agent, to overcome the instability which results from removal of the natural buffering agents, the 'non-penicillins', during manufacture of crystalline penicillin G solutions. 'Buffered Crystalline Penicillin G' will be available in containers of 0.2, 0.5, 1.0, 5 and 10 m.u. from December 4, 1950, at the same price as the non-buffered material. (The Distillers Company (Biochemicals) Ltd., Speke, Liverpool 19. Distributors: Allen & Hanburys Ltd.; British Drug Houses Ltd.; Burroughs Wellcome & Co.; Evans Medical Supplies Ltd.; Imperial Chemicals (Pharmaceuticals) Ltd.; Pharmaceutical Specialities (May & Baker) Ltd.)

'CUPRIMYL' brand cuproxoline is available as a solution of cuproxoline and procaine hydrochloride for intramuscular injection in the treatment of rheumatoid arthritis and other rheumatic conditions. It is introduced as an alternative to gold compounds. Issued in boxes of 10 ampoules of 5 ml., each containing 0.5 g. cuproxoline and 25 mg. procaine hydrochloride. (May & Baker Ltd., Dagenham, Essex.)

NEO-FERRUM (Crookes) is produced in two new forms: NEO-FERRUM (INFANTS) and NEO-FERRUM (INTRAVENOUS). The former is a liquid preparation of colloidal ferric hydroxide which has been specially prepared to facilitate dosage for infants up to twelve months. It is issued in ½-ounce bottles with pipette. 'Neo-Ferrum Intravenous' is issued in ampoules of 5 ml. (each containing 100 mg. elemental iron), in boxes of 6. Its use is indicated in the treatment of deficiency anæmias, and the toxicity is stated to be so low that up to 250 mg. of iron can be given in a single injection. (Crookes Laboratories Ltd., Park Royal, London, N.W.10.)

'PROCID' NASAL DROPS, a stable solution containing sodium propionate 5 per cent., and ephedrine hydrochloride 0.8 per cent., have been prepared for the treatment of incipient common colds, rhinitis, nasopharyngitis and sinusitis. The drops are available in ½-ounce dropper bottles, and in bottles of 1 ounce without dropper. (Harker Stagg Ltd., 8 St. George Street, London, W.1.)

NEW APPARATUS

AMPLIVOX MODEL 70 PORTABLE AUDIOMETER.—This new hearing test instrument, which has been produced for routine audiometric testing of schoolchildren and industrial workers, is stated to be simply operated and extremely accurate, with tolerance within the published requirements of the Medical Research Council and the American Medical Association. It provides for air-conduction testing at eight pure tones, with frequencies from 125 to 8000 cycles per second, and maximum intensity range of 100 decibels in 5 decibel steps. There is a zero reference, so that the same figures are read on the hearing loss scale for all frequencies, thus permitting testing by the rapid sweep check method. Price 80 guineas complete. (Amplivox Ltd., 2 Bentinck Street, London, W.1.)

THE SURQUALATIC STERILIZER is stated to be 'the only upright electric instrument sterilizer on the market totally encased in a jacket made from heat resistant material which allows it to be safely handled when in use'. The

instruments are held vertically and separately in a tray, which is hooked underneath the lid of the sterilizer; the tray is stepped so that condensation falls back into the container; it is deep enough to accommodate small bottles and the like. (Surgical Equipments Supplies Ltd., Westfields Road, Acton, W.3.)

MEDICAL FILM

Oxygen Therapy (16 mm. sound—running time 35 min.) has been produced by Kinocrat Films Ltd. for Oxygenaire Ltd. The film, which is in two parts, deals with the history of the clinical use of oxygen, the physiological aspects of

CONTINUED ON PAGE 660

oxygen in the lungs, blood stream and blood plasma, the symptoms and main types of anoxia (part I). Part II demonstrates the different techniques of oxygen administration for infants, children and adults, the latest forms of oxygen equipment, and measures for the prevention of fire. (Oxygenaire (London) Ltd., 8 Duke Street, Wigmore Street, London, W.1.)

HUTCHINSON TRIENNIAL PRIZE

THE London Hospital Medical College offers a prize of £60 for the best essay, written in English, on '*Factors Influencing Growth in Length of Bone*', to be delivered at the Hospital by October 31, 1953. Candidates must be full students of the London Hospital; they may be qualified.

COURSES ON MEDICAL ASPECTS OF ATOMIC WARFARE

COURSES of instruction on this subject at the Royal Naval Medical School, Alverstone, Hants., are now available to Medical Officers and Wardmaster Officers in the Royal Navy, Medical Officers of the R.N.V.R., and civilian members of the nursing profession.

LONDON NURSING EXHIBITION

THE 35th annual London Nursing Exhibition and Professional Nurses and Midwives Conference, held under the auspices of the *Nursing Mirror*, well maintained the high standards of what has now come to be recognized as one of the most important events in the nursing calendar. Over fifty companies participated in the exhibition, their wares ranging from textbooks to corsets, nursing uniforms to baby foods, watches to hospital equipment. The general standard of the stands was commendably high. What was perhaps even more impressive was the programme of lectures which covered the whole week and included many of the most eminent names in the medical profession. A special feature of the exhibition was a graphic display of nursing in atomic warfare, organized by the Ministry of Health. Much of the success of the exhibition is due to the honorary convenor, Major-General R. J. Blackham.

CENTENARY OF FAMOUS MENTAL HOSPITAL

FRIERN HOSPITAL, long famous as Colney Hatch Asylum, celebrated its centenary on October 27. Its foundation stone was laid by the Prince Consort in May 1849, and the 'Victoria Fund', to assist those discharged as cured, was opened with a subscription of £100 from the Queen. The building was ready for occupation in October 1850, and from the beginning humane treatment by non-restraint was employed. Today the Hospital has accommodation for some 2,500 patients and 800 staff.

PUBLICATIONS

Pædiatrics in North-Eastern Scotland.—The pædiatricians were quick to take advantage of the coordination provided by the regionalization introduced by the National Health Service, and there is little doubt that theirs is the specialty which has made the greatest progress since the introduction of the N.H.S. In a booklet entitled 'Pædiatrics in the North-Eastern (Aberdeen) Region of Scotland', Professor John Craig and Dr. Joan Burrell of the Department of Child Health in the University of Aberdeen, provide a general review of the pædiatric service in this region. As the authors point out, 'The North-Eastern Region of Scotland, so circumscribed geographically, has had a culture of its own for hundreds of years and is well adapted for the regionalization of the child health services'. Professor Craig has the further advantage of being a member of a Medical School which was completely replanned before the outbreak of the 1939-45 war and now occupies one of the finest sites of any medical school in Great Britain. This review will well repay careful study by all who are interested in child health. Although dealing primarily with conditions in one region, it contains many lessons of value to other parts of the country. (Aberdeen: The University Press, 1950).

The Dawson Report.—The current interest, not only in this country, in hospital and health care on a regional basis has led to a revived demand from students of hospital administration and others for the 'Interim Report on the Future Provision of Medical and Allied Services (1920)', commonly referred to as the 'Dawson Report'. Since the Report has long been unobtainable from H.M. Stationery Office, King Edward's Hospital Fund for London has, with permission, had a limited number printed. Copies may be obtained on application to the Fund at 10 Old Jewry, London, E.C.2.

BCG—Protection against Tuberculosis.—NAPT Leaflet No. 36 deals lucidly, as well as guardedly, with the value of BCG in protecting against tuberculosis, but emphasizes that it is not a cure. (Tavistock House North, Tavistock Square, London, W.C.1. Specimen copies free; larger numbers 7*s.* 6*d.* per hundred.)

Royal Army Medical College Calendar.—The Calendar for 1950-51 contains an historical sketch of the College from its official beginning in 1857 to the present time. An interesting account is also given of earlier schools of military surgery. (Commandant and Director of Studies, Royal Army Medical College, Millbank, London, S.W.1.)

CONTINUED ON PAGE 662

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Hospitals in U.S.A. and Canada.—'A Report by Mr. S. W. Barnes, House Governor of King's College Hospital, after visiting hospitals in the United States and Canada', March-June 1949, makes interesting reading. Mr. Barnes had an opportunity of seeing a large number of hospitals and organizations in New York, Philadelphia, Baltimore, Washington, Chicago, Ann Arbor, Boston, Cleveland, Toronto, and Montreal, and he gives his impressions of the hospital services in the two countries. Commenting on the excellence of plumbing, the automatic bedpan washers, the ward stations as essential units, and the high standard of catering in American hospitals, he makes several valuable recommendations for hospitals in this country. A visit to America has confirmed his admiration for British hospital sisters. (House Governor, King's College Hospital, Denmark Hill, London, S.E.5.)

Winter on the Sussex Coast.—A complimentary copy of the fourth edition of this useful and pleasantly illustrated guide will be sent to doctors on application to the Publishers, Crabtree Press Ltd., 57 Tivoli Crescent, Brighton.

The Sex Hormones.—Ciba Laboratories Ltd. have brought out a fourth edition of the practical as well as elegant handbook, 'The Sex Hormones' (1950, pp. 186). A survey of their chemical constitution, biological properties, and clinical applications, it contains a classified scheme of dosage and details of sublingual and depot therapy. A 20-page bibliography is appended. This publication is available to members of the medical profession on request. (Ciba Laboratories, Horsham, Sussex.)

National Foot Health Week.—We have received a Report and Comment on Britain's first national foot health week, June 12 to 17, 1950, organized by the Foot Health Educational Bureau. The exhibition was seen by nearly 5000 people. The second part of the brochure deals with the future of the Shoe Trade and with the conflict between fit and style. (121 Ebury Street, London, S.W.1.)

Latex Foam in the Hospital.—An illustrated booklet, issued by The British Rubber Development Board, in presenting some facts about Latex Foam tells 'how to eliminate all the expense and inconvenience of re-making mattresses, how bed making and other ward work can be made much easier, and how bed fatigue and bed sores can be reduced'. (Market Buildings, Mark Lane, London, E.C.3.)

OFFICIAL PUBLICATIONS

Cancer Registration in England and Wales, by Percy Stocks, C.M.G., M.D., F.R.C.P. Chief Medical Statistician, General Register Office, is the third in the series of 'Studies in Medical and Population Subjects'. This new report consists of an inquiry into treatment and its results, based upon a statistical review of the case records of the 70,000 patients with cancer first registered for treatment during 1945 and 1946 under the scheme of coordinated registration evolved by the General Register Office, the Ministry of Health and the Radium Commission. This scheme started slowly, but by 1948 more than 250 hospitals were taking part, and the new cases registered annually by these hospitals and recorded at the General Register Office amounted to about one-half of the estimated annual total of new cases in the country. This report will prove of great interest to all concerned with the treatment of malignant disease and promises well for the value of subsequent reports on the follow-up of these patients. (H.M. Stationery Office, price 2s.)

Notes on the Diagnosis of Occupational Diseases.—The Ministry of National Insurance has published as a booklet useful notes for the guidance of medical practitioners who have to examine, and report on, claimants for benefits under the Industrial Injuries Acts for prescribed diseases. In the first part are included the various industrial poisons, anthrax, ankylostomiasis, chrome ulceration, compressed air illness, miner's nystagmus; the second and third parts are devoted to pneumoconiosis and byssinosis respectively. (Obtainable from H.M. Stationery Office, price 1s. 6d.)

Northern Ireland Hospitals Authority.—The first annual report of the Northern Ireland Hospitals Authority for the period March 25, 1948 to March 31, 1949, discusses the work of its various committees and of the hospitals, the Domiciliary Visits Scheme, provision of appliances, the Blood Transfusion Service, the building programme, and finance, and pays tribute to voluntary organizations for continuing to give excellent assistance for the benefit of patients. (58 Howard Street, Belfast.)

PUBLISHERS' ANNOUNCEMENT

NOTES FOR THE PATIENT WITH INDIGESTION, *The Practitioner* pamphlet referred to by Professor F. H. Bentley in his article on 'The Peptic Ulcer Problem' (p. 626), is available to doctors for distribution to patients. Price 6d. per copy; 10 for 4s. 6d.; 50 for £1 1s. 6d; 100 for £2—post free.

INDEX AND BINDING CASES

THE index to Vol. 165 (July-December, 1950) will be forwarded to all subscribers with the January, 1951, issue. Binding cases for this and previous volumes are available in green cloth with gilt lettering, price 4s. each, post free. The cases are made to hold six copies after the advertisement pages have been removed; they are not self-binding. Alternatively, subscribers' copies can be bound at an inclusive charge of 10s. 6d. per volume; this includes the cost of the binding case and return postage.

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THE PRACTITIONER

Fifty Years Ago

'If a man begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties'.—Francis Bacon: *Advancement of Learning*.

DECEMBER, 1900

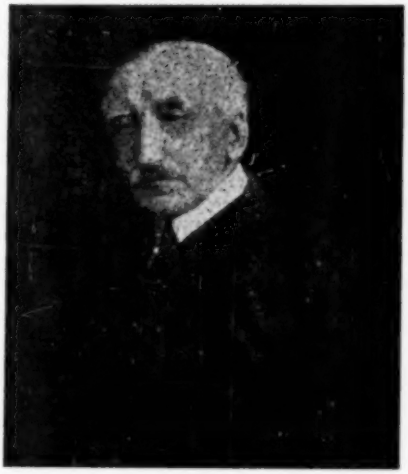
A PROPOSED Federation of Paris Medical Societies through the amalgamation of the Société Médico-Chirurgicale and the Société de Thérapeutique of Paris reminds the Editor that on several occasions *The Practitioner* had advocated an amalgamation of the principal medical societies of London into an Academy of Medicine: 'This would be of the greatest possible advantage to the profession and to medical science. It would also be very decidedly to the advantage of some of the older societies themselves. Their meetings are ill-attended, and it is getting more and more difficult to get papers of the right kind. Men who have any new thing to announce naturally do not care to deliver their message to a congregation recalling Swift's "dearly beloved Roger". At any rate they would doubtless say with the poet, "Meet audience let me find though few". But the audiences at some of the most venerable of the London medical societies are often as deficient in meetness as in numbers'.

'A febrifuge for khaki fever' is the picturesque editorial description of Sir Frederick Treves's book 'The Tale of a Field Hospital'—'very suitable for a Christmas present for boys, in whom it may help to subdue the war fever engendered by a surfeit of khaki literature'. The author ' wields a pen as incisive as his scalpel . . . He saw war as it really is, and he paints it with the lurid power of a Verestchagin. His descriptions have all the vividness of Rudyard Kipling without the vulgar triviality of detail which sometimes mars that skilful writer's effects'.

Treves was appointed a civilian Consulting Surgeon to the Army towards the end of 1899, and was put in charge of a Field Hospital which accompanied the Ladysmith Relief Column. He was awarded the C.B. and K.C.V.O. for his services.

The first of the 'Original Communications' entitled 'Oral Sepsis as a Cause of "Septic Gastritis", "Toxic Neuritis", and other Septic Conditions', from the pen of the late Dr. William Hunter, is one of the classic papers in modern medicine. The author recalls a case he saw some years ago, which 'definitely proved the connection between oral sepsis and one of its commonest effects—one so marked and so common that I have designated it by a special name, *Septic Gastritis*', and he comments on 'the extraordinary degree to which oral sepsis is overlooked, alike by all parties concerned—the physician, the surgeon, the patient'.

William Hunter (1861-1937), the 'Father of Oral Sepsis' and the originator of the modern concept of focal infection, after receiving his medical education at Edinburgh University and studying abroad, came to London in the early 'nineties. Most of his professional life was de-



Vandyk

William Hunter, C.B., M.D., F.R.C.P. (1861-1937)

voted to Charing Cross Hospital, which he served in turn as pathologist, pathological curator, dean, and physician. He built up its department of pathology and bacteriology, where he continued his researches begun as John Lucas Walker student at Cambridge in 1885, on the relationship between focal sepsis and the severe anæmias. Stressing the importance of dental infection as a cause of local and general bodily disturbances, he introduced the term 'oral sepsis' (*Brit. med. J.*, 1900, **ii**, 215), and in a delightful article, 'The Coming of Age of Oral Sepsis' (*Brit. med. J.*, 1921, **i**, 859), he wrote: ' "Oral Sepsis" celebrates her coming of age—the 21st anniversary of her appearance in medical literature under her new name. She

FIFTY YEARS AGO—*continued*

made her entry very quietly, shyly, and even apologetically'. William Hunter will also be remembered in history for his careful investigations on pernicious anæmia, which included his description of glossitis—attributed to oral sepsis.

'A Medico-Literary Causerie' deals with poisoners, old and new: 'In an age when France was made illustrious by the genius of Racine and Molière, Paris swarmed with sorcerers, witches, pythonesses, astrologers, and all kinds of imposters who pretended to tell the future'. The toxic agents then most popular with the poisoners were arsenic, opium, and cantharides, their mode of administration being varied with considerable ingenuity. 'Whatever were the poisons used, there was little risk of detection by the doctors of the day'.

'Hernia: its Etiology, Symptoms, and Treatment', by W. McAdam Eccles, then Assistant Surgeon to the West London Hospital and to the City of London Truss Society, is reviewed rather critically, though ending on a note of praise: 'Throughout one notes a tendency to omit entirely all reference to the work of others; there is no bibliography, and the references by name to other surgeons are scant, although their work is utilised'. The reviewer regrets that the author 'has nothing to tell us about recurrent hernia. The truss Society gets many of the failures following operation, and we should have been thankful to hear what the truss authorities have to say about them'.

'Golden Rules of Ophthalmic Practice', by Gustavus Hartridge, F.R.C.S., 'reminds us of Bovril, which the advertisements inform us contains an ox in a teacup. Here we have the subject of diseases of the eye served up on 65 pages measuring 2½ inches by 5 . . . We commend this little book to such as have a taste for very concentrated extracts'.

In the section 'Novelties and New Preparations', it is interesting to read that 'Oxo' was placed on the market fifty years ago by the Liebig's Extract of Meat Company. 'It will be found very useful in the sick-room, especially amongst those who cannot afford the more expensive preparations that have been elaborated during recent years. The cost of a 2-oz bottle is only 10d.'. Another 'useful novelty' is 'urotropine (Burroughs Wellcome & Co.)—'an antiseptic to the genito-urinary system . . . probably the best drug to use in cases of septic cystitis'.

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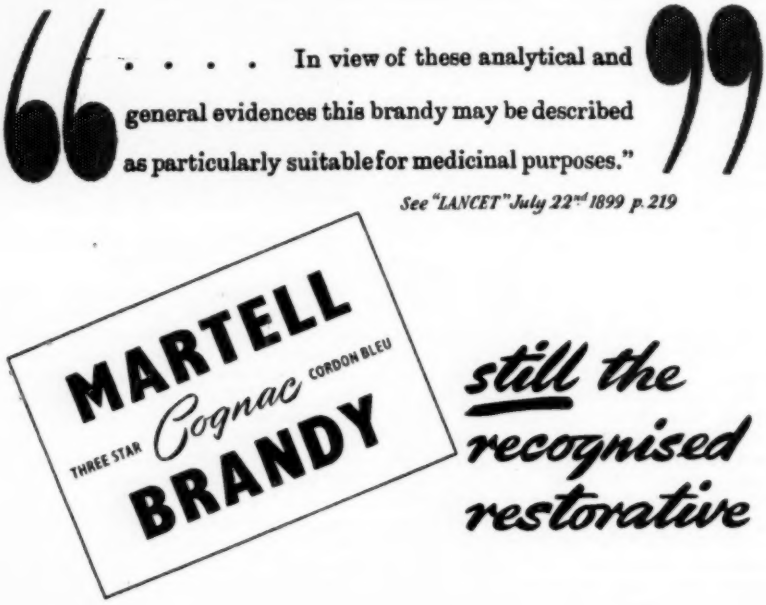
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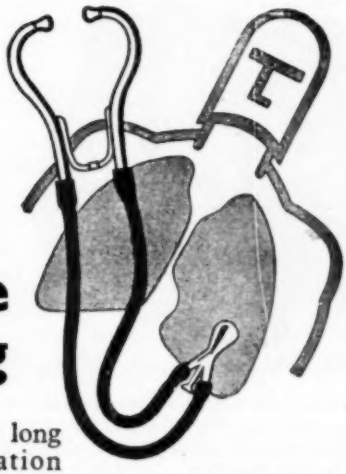

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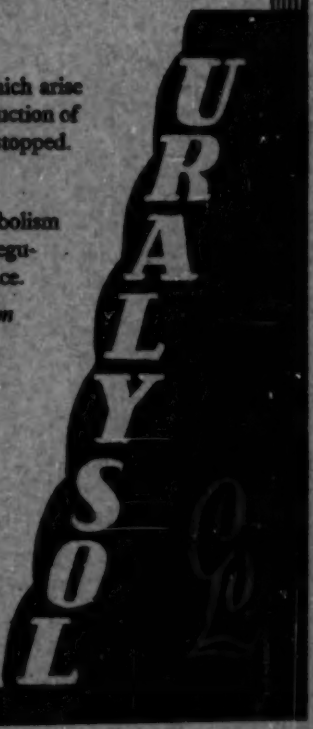

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